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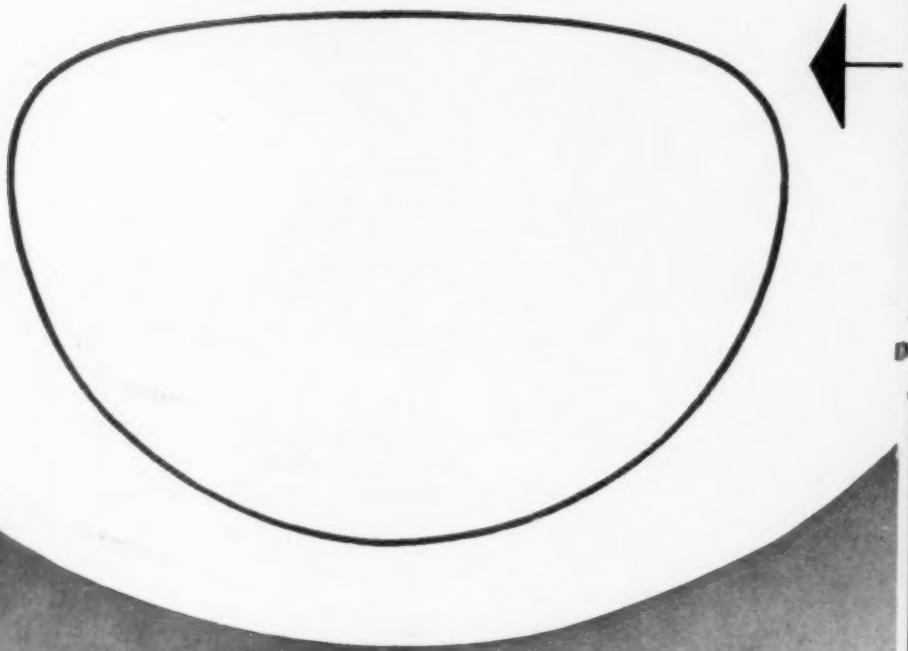

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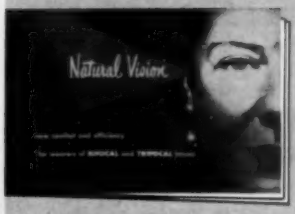

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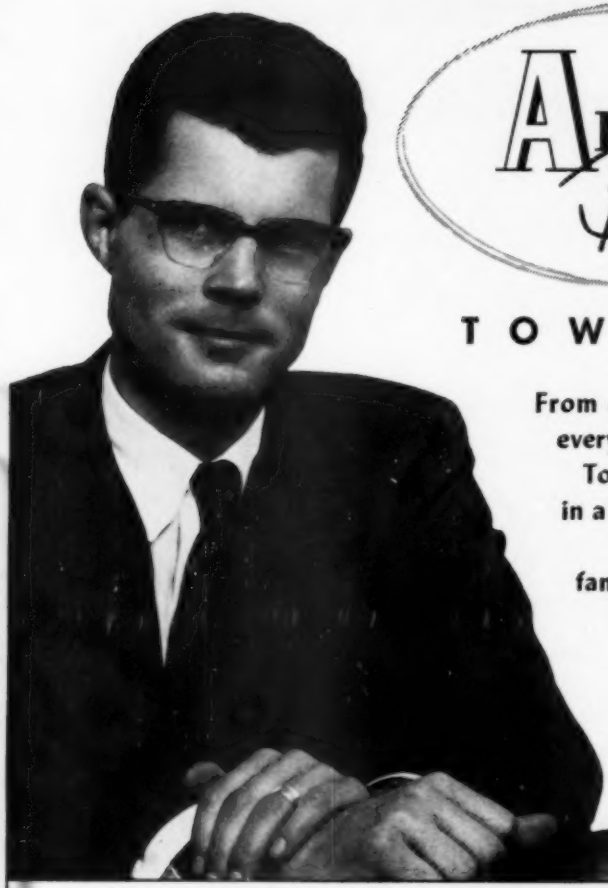

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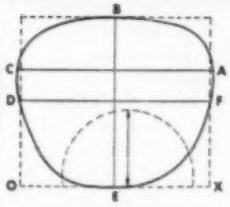

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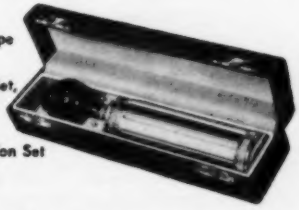

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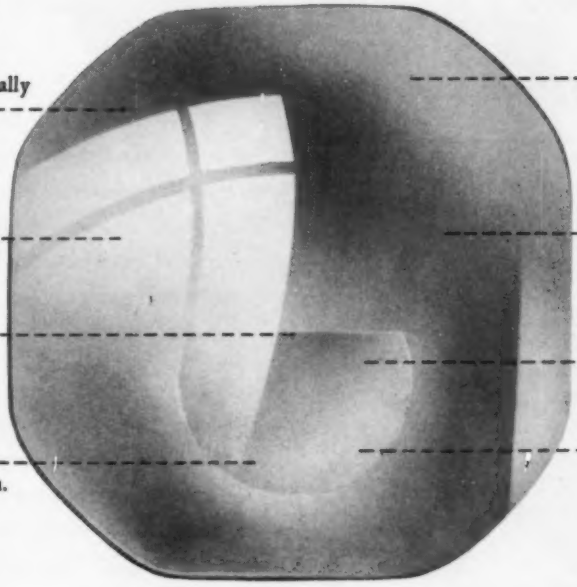

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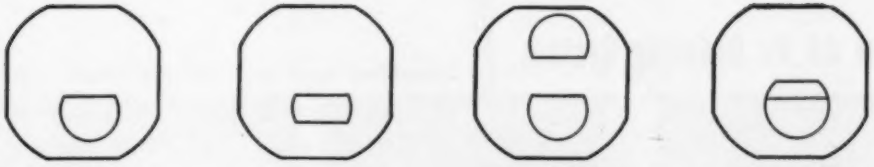

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Vol. 28 October, 1951 No. 10

THE OPTOMETRIST AND FIRST AID IN WAR TIME*

John Collins Neill†
Pennsylvania State College of Optometry
Philadelphia, Pennsylvania

Once more we see the citizens of our country mobilized into units for training in the protection and defense of our homes in the event of an enemy attack. This mobilization is going forward at every governmental level, in towns, cities and states; and all these activities are being coordinated by a national headquarters for civilian defense.

The organization of civilian defense has many facets including those of fire-fighting, police protection, transportation, ambulance service, nursing and first aid, to mention but a few. Unquestionably one of the most important units of civilian defense is the one concerned with the problem of first aid.

In the present-day mobilization of civilian defense, great emphasis is being placed on the possibility of a major disaster which might result from an atomic bomb explosion. At every level of the organization of civilian defense, members are being informed of all that is known concerning the results to be expected from the detonation of atomic weapons.

Currently, the executive personnel of all professional organizations, such as medicine, dentistry, osteopathy, nursing and the other health professions, are holding meetings and giving lectures to acquaint their members with all that is known to date concerning the methods of caring for the victims of an atomic bombing. As time goes on and the civilian defense organization becomes better developed, all those who are engaged in pursuits concerned with the public health will be called upon more and more for their counsel, their specialized knowledge and their leadership. As optometrists, we must not be found wanting in this important undertaking.

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*Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 16, 1950. For publication in the October, 1951, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist. Member of faculty. Fellow, American Academy of Optometry. Chairman, Contact Lens Section.

Indoctrination in the principles of first aid and, more especially in first aid treatment of eye injuries, should begin now. Many recent graduates of our schools and colleges of optometry have had such indoctrination. It is the optometrist's moral duty to be prepared to offer adequate and intelligent first aid in all cases of eye injuries, whether such injuries stem from an atomic bomb explosion or any other cause.

The following discussion of the use of first aid to the eye in emergencies will follow the pattern set by the directors of similar courses in the other health professions. First, we shall consider the atomic bomb and the results that may be expected from its detonation: and second, we shall discuss the problems of first aid to the injured eye in all types of emergencies.

PART I

THE ATOMIC BOMB

General Data: The medical effects of the explosions over Hiroshima and Nagasaki[1, 2] were first studied by the Joint Commission of Medical Officers of the Army, Navy and Manhattan District. Further studies are now being carried out by the Atomic Bomb Casualty Commission of the National Academy of Science's National Research Council. This work is being financed by the Atomic Energy Commission.

The results produced by an atomic bomb vary with the methods of explosion. In general, there are three basic types of effects produced. These are: (a) *thermal effects*, from the radiant heat of the burst and from fires which start in the wreckage; (b) *mechanical effects*, as a result of the blast produced; and (c) *radiation effects*, from the radioactivity released by the burst.

Hiroshima, Nagasaki and the first Bikini test may be taken as typical examples of an explosion in air. At Hiroshima and at Nagasaki, a majority of the deaths and injuries resulted from blast effects due to the collapse of buildings and the falling of debris. Many additional casualties resulted from flash burns or secondary burns incurred in the fires that raged after the explosion. Fifty to 60 per cent of the casualties observed were due to blast effects and flame burns, 20 to 30 per cent to flash burns, and 15 to 20 per cent to radiation effects. However, had there been protection from blast and fire, nearly as many people would have died from radiation effects alone. Death in all cases was officially attributed to the most obvious cause, either blast or burns. For example, an individual crushed by falling concrete after being seriously burned was classified as a blast casualty, although the amount of radiation received undoubtedly would have caused death anyway, even if the blast or burn injuries had not proved fatal.

Berens[3] describes each of the three effects of the atomic bomb as follows: *Thermal Effects:* At the instant of an atomic bomb explosion, temperatures are generated which approach those of the sun at its center. A "ball of fire" is produced which spreads rapidly from the bomb to a surrounding area about 300 feet in diameter. This ball of fire gradually loses its brilliance and its heat in the resulting atomic cloud and the surrounding atmosphere. Almost any substance within the area of the ball of fire is burned up completely. Even metals are fused or vaporized and certain types of soil and rocks are fused to a glass. Beyond the area covered by the ball of fire, secondary fires are started by the great amount of heat. These fires add their effects to the already tremendous thermal updraft which carries the ball of fire and the accompanying atomic cloud upward to a height of 50,000 to 60,000 feet in a matter of minutes. The flash burn effect of the ultra-violet radiation produced by the explosion is also a powerful factor. This effect is almost instantaneous, the temperature of an exposed individual's skin being raised as much as 50° C. by the flash in the first one-thousandth of a second at a range of 4,000 yards. This is because there is no time for cooling to occur. Flash burns can be prevented by a minimum amount of shielding. Such burns will occur only on those parts of the body which are exposed to the source of the flash, so that unilateral burning is the rule. Light clothing gives much better protection than does dark clothing. In fact, pattern burns were seen frequently on Japanese survivors where light-colored portions of the clothing had protected the skin while the dark portions had not.

Permanent injury to the eyes as a result of looking at the flash has not been observed to any extent, but a temporary blindness has been experienced by individuals who looked at the flash from a distance of 10 miles. There is every reason to believe, therefore, that permanent retinal damage would result from a closer direct exposure. Every wave length of the spectrum from the ultra-violet to the infra-red is released during an explosion and the heat wave which is carried outwards by the blast is appreciable at a distance of 10 miles. The flash is clearly visible to observers over 200 miles away.

Within a half-mile radius of the point directly under a bomb explosion—the point called "ground zero"—for a bomb of the type used against Japan and detonated at a height up to several hundred feet in the air, the following effects would be noted:

Intense thermal energy generated by the blast would cause fatal burns to unprotected persons and would start fires in the wreckage.

From one-half to one mile from ground zero, second and third degree flash burns would be suffered by people not adequately protected.

From one mile to one-and-one-half miles from ground zero, fire damage would be extensive in inflammable areas. Flash burns can be expected at this distance.

From one-and-one-half to two miles from ground zero, flash burns would not be so severe as in closer areas.

At distances over two miles from ground zero, second and third degree flash burns are possible, but beyond two-and-one-half miles the danger apparently disappears.

Blast Effects: Although the quantity of fissionable material which constitutes a critical mass is secret information, it is known that the blast effects produced by an atomic bomb explosion are equivalent to those which would result from the instantaneous detonation of 20,000 tons of TNT explosive. This figure was calculated for bombs of the type used in Japan.

Within a half-mile of ground zero, the blast pressure created by the bomb explosion would demolish all buildings not of reinforced concrete or steel construction. Well-constructed buildings of steel and concrete would suffer structural damage up to 70 per cent of total destruction, with severe damage to windows, partitions, walls and contents. Persons not sufficiently protected by shelter able to withstand the blast would undoubtedly be killed by parts of falling buildings or flying wreckage.

In areas outside a half-mile radius and up to one mile from ground zero, the structural damage due to blast and fire would be general. Residential buildings would be almost totally destroyed. Only fire and shock resistant buildings would be immune to any appreciable extent. Casualties from attendant types of injury—flame burns, blast effects and injuries caused by falling debris and flying glass—would be prominent.

In the area from one to one-and-one-half miles from ground zero, blast damage would still be extensive to residential structures. Fire damage would be extensive in inflammable areas. Natural barriers such as steep hills could be expected to afford protection at this distance, as was the case at Nagasaki.

At Hiroshima structural damage was limited generally to an area of radius two miles from ground zero. The limits of fire damage coincided roughly with this area except where wind caused wider effects. The maximum distance of a recorded structural damage at Hiroshima was 4.1 miles from ground zero.

An atomic bomb explosion is accompanied by a positive pressure wave which directly produces the blast effect. This is followed immediately by a wave of negative pressure which develops in a large area sur-

rounding the explosion. This negative pressure effect combined with the decreased pressure effect at the epicenter which is produced by the tremendous thermal updraft causes a delayed, violent inrushing of winds in all directions opposite to the blast wave. Thus, a minute or so after the explosion, a great quantity of material and debris will be hurled towards the point of detonation. An individual who was fortunate enough to escape the original blast because of effective shielding might well become a casualty a few minutes later during this second phase. This second phase is of considerable duration. The resulting high winds contribute materially to the secondary fires and to the general chaos produced by the primary phase. This effect is called the "fire storm." Whole areas untouched by the blast will be burned out. Within a circle roughly six miles in diameter, hundreds of fires may be started, the number and intensity depending on the type of structure, the terrain, prevailing winds, etc.

Radiation Effects: The efficiency of an atomic detonation is relatively low and the range of the direct action of the fission products is relatively restricted. Therefore, the danger of radiation effects from this source are relatively small except in the case of an underwater blast where the radioactive fission products are fairly well confined in the rising water column and deposited heavily in the immediate vicinity of the blast. In the case of an air burst, most of the fission products are carried into the air by the thermal updraft and later disseminated and diluted by the winds so that they constitute a relatively minor hazard. While their presence can be detected hundreds of miles away from the source of the detonation and thousands of feet above the earth, the quantity of radiation at any one area is usually insignificant. It might, however, become dangerous in the event of a heavy rainfall following the explosion. It would be possible for rain, falling through a radioactive cloud, to precipitate dangerous quantities of active particles on the surface of the earth many miles from the original source.

Perhaps the most significant factor in determining the radiation effects of an atomic bomb explosion is the location of the bomb at the time of detonation. The bombs at Hiroshima and Nagasaki were exploded at altitudes of about 2000 feet. Since the "ball of fire" did not touch the earth, and since most of the fission products were carried upwards in the rapidly rising cloud of smoke, the extent of contamination was small so that even a few minutes after the explosion, the area did not present a radiation hazard.

Atomic bombs were exploded experimentally at low altitudes at Alamogordo and at Eniwetok. In these cases, the amount of radioactive

contamination of the ground was many times greater than that for high altitude bursts. This is due to the fact that the ball of fire touched the earth's surface. Another factor contributing to greater contamination in low level bursts is the fact that debris and dust are sucked more quickly into the updraft and into better contact with the ball of fire, where they become highly contaminated with radioactive particles. Subsequently, this material will settle to the earth and will contaminate areas far away from the center of the explosion.

An underwater detonation of an atomic bomb does not create widespread damage from blast effects and from heat because of the muffling action of the water. But in contrast to a high air explosion, the residual radioactivity is of considerable concern. Much of this radioactivity will be absorbed by the water surrounding the bomb, but the radioactive fission products will be carried in the water comprising the rising water column and the atomic cloud. When the water column descends, it will deposit radioactive materials over the surrounding country. Also, the rain and mist which constitute the "fall-out" of this type of explosion, will spread dangerous radioactive materials over a wide area, the extent depending on wind direction and wind velocity. Roughly speaking the lethal area may extend for a half-mile upwind and two or more miles in a downwind direction.

As was said before, radiation injury would not be the main factor in casualty production if the bombing were confined to an above the surface type. At a radius of 1.3 miles from the epicenter, most of the personnel exposed would receive a lethal dose of radiation but, unless they were well-shielded by concrete or metal structures, they would also be casualties from other causes. From a distance of 1.3 to 2 miles from the epicenter, enough radiation would be received to complicate recovery from other injuries, although it is doubtful if fatalities would result from radiation injury alone. Beyond the two-mile limit, there would be practically no danger from direct radiation, the only serious hazard being that from the "fall out" of the explosion.

Some idea of the casualty producing properties of the atomic bomb may be had from the statistical results of a special survey conducted by members of the faculty of the Tokyo Imperial University in November, 1945, in Hiroshima. This group was able to obtain exact data on 898 persons with some degree of scientific accuracy. A summary of their observation follows:

There were 507 deaths among this number. The death rates at each distance were: at 0.50 km., 98.4 per cent; from 0.6 to 1.0 km., 90 per cent; from 1.1 to 1.5 km., 45 per cent; from 1.6 to 2.0 km., 22.6

per cent. The death rate for the total area within a radius of 2.0 km. was 56.6 per cent.

Out of the 507 deaths, it was possible to prove the exact date of death, and it was shown that 73.5 per cent died on the date of the bombing, another 9.3 per cent succumbed by the end of the first week, another 3.9 per cent by the end of the second week and only 13.3 per cent survived beyond two weeks.

In 400 cases of the 898 studied, it was possible to determine accurately the nature of the injuries and it was computed that 35.3 per cent had burns, 60.3 per cent had blast injuries and 28.6 per cent had some sort of radiation injury. In another similar study of 5,120 persons who survived the blast, 98.3 per cent had primary burns and 21.2 per cent had non-fatal radiation injuries. It is probable that not more than 10 per cent were injured by radiation alone, although it is estimated that about 15 to 20 per cent of the deaths were ultimately due to this cause either directly or indirectly.

Six months after the bombing of Hiroshima, the Prefecture reported on February 2, 1946, the following casualties: 78,150 deaths, 13,983 persons missing, 9,428 persons severely injured and 176,987 persons suffering minor injuries. These figures do not include the military forces so it is estimated that the total number of deaths approached close to 100,000.

From an examination of the statistics of all of the surveys which have been made by the Atomic Bomb Casualty Commission, one derives a rather pessimistic view of the value of rescue and first aid work near the epicenter of an atom bomb explosion. However, in densely populated areas, which are the natural targets for such bombings, there will be thousands of persons suffering all sorts of casualties in the perimeter regions who will be in dire need of immediate and adequate first aid treatment.

We have divided the effects of an atomic bomb explosion into three basic types of injuries, namely (a) thermal, (b) mechanical or blast and (c) radiation. From the standpoint of first aid and subsequent medical treatment, it is not necessary to differentiate between burns caused by thermal radiation, by flame or by contact. Although there are differences with respect to the extent of body surface involved, depth of the injury to the skin, etc., the indicated treatment for burns due to an atomic explosion appears to be the same as for those encountered in large scale incendiary bombings and in civilian conflagrations.

Blast or mechanical injuries vary from complete crushing, severe fractures and serious lacerations with hemorrhages to minor scratches,

bruises and contusions. Treatment for such injuries would follow the usual pattern for similar injuries received in civilian life.

It has long been known that excessive exposure to any radiation—for example, x-rays, alpha and beta particles, gamma rays and neutrons—capable of producing ionization in living tissues, can cause injury to the organism. After the discovery of x-rays and of radioactivity toward the close of the century, serious and sometimes fatal exposure to the radiations were sustained by radiologists, chemists and physicists before the dangers of such rays were fully realized. As a rule, the exposures in these cases were limited to certain parts of the body and the effects were referred to as radiation injuries. These included local destruction of tissue, loss of hair and temporary sterility. In a very few instances there occurred accidental exposure of large parts of the body to an overdose of radiation which led to serious systemic difficulties in addition to the local effects. This systemic effect is called radiation sickness.

Before the bombings of Hiroshima and Nagasaki, radiation sickness was a disease of rare occurrence. But in these attacks, large numbers of individuals were exposed to gamma rays of varying intensities and radiation sickness became better known. The course of illness in acute radiation sickness can be divided into four phases.

Phase 1. Within an hour or so after exposure, the patient becomes nauseated, starts to vomit and suffers general malaise. Diarrhea may occur and the blood pressure may fall a little. In general, the heavier the dosage, the greater will be the extent of the patient's illness.

Phase 2. After the onset of the illness, symptoms tend to subside and, for a period of a few days to that of several weeks, the patient feels less ill. The heavier the dose of radiation the shorter is this period of temporary and partial relief.

Phase 3. The illness reaches its height during this phase. There is apathy, fever, rapid pulse, loss of appetite, loss of weight, nausea, and severe bloody diarrhea. Petechiae appear under the skin and bleeding develops in the gums. In severe cases infected ulcers spread throughout the area of the mouth. The hair falls from the head and the body after about three weeks. Examination of the blood indicates destruction of the white cells and a fall in the number of red cells and of platelets.

Phase 4. Those who survive the third phase now enter a period of convalescence during which weakness and fatigue are the outstanding symptoms. It may be months before the individual regains normal strength and weight. Usually, within six months the patient has completely recovered and appears normal in every respect.

Up to this time there is no known method of preventing the death

of cells and of tissues injured by a heavy dose of radiation. Treatment consists in fighting infections normally fought by the white blood cells with the use of drugs such as penicillin. Blood transfusions are given to supply red blood cells and drugs such as toluidine blue are administered to reduce the production of hemorrhages.

The possible delayed effects of radiation are being studied in Japan as part of a long range program of the Atomic Bomb Casualty Commission. Except for a number of cases of cataract, nothing significant has been observed among the population four years after the atomic bomb explosion that can be classed as representing permanent effects of the bombing.

Because of the discovery of cataracts in a number of cyclotron workers about three years or so after exposure to excessive amounts of radiation, probably of neutrons, the Atomic Bomb Casualty Commission has made a detailed study of the incidence of cataract among the survivors of the bombing of Hiroshima and Nagasaki. By early 1950, 45 cases of cataracts had been identified in persons who were within 3,300 feet from ground zero at the times of the respective explosions. The cataracts are similar to those which have been previously associated with over exposure to x-rays and gamma rays, and hence they have probably been caused by the initial radiations from the atomic bombs.

Cogan, Martin and Kimura[4] report on 10 cases of atomic bomb cataract. All of the patients were said to have had normal vision prior to the bombing and for some time afterward. There were seven males and three females. Ages varied from 13 to 55 years. All were within 550 to 950 meters from the explosion. The incidence of atomic bomb cataracts in existence now, or to be expected in the future, is not known. However, it seems significant to note that a group of 1,000 persons, believed to be a cross section of the existing survivors, were examined and no radiation cataracts were found among them.

PART II

FIRST AID TREATMENT OF EYE INJURIES

General Data: Previously in this paper it is mentioned that the types of injuries and burns resulting from an atomic bombing are no different from those which might be expected to result from any other type of bombing or for that matter, from any type of civil accident. The treatment, therefore, accorded any type of injury or burn resulting from an atomic explosion will necessarily be the same as the treatment for the same kind of injury acquired in any other manner. This statement applies equally well in the case of eye injuries, so that a general review

of the latest approved methods for the initial treatment and handling of common eye injuries will now be in order.

Nature must have appreciated the danger of injury to our eyes when she placed them in their strong, bony-walled orbital cavities, cushioned them with orbital fat and covered them with movable eyelids, for otherwise the number of ocular injuries as a result of accidents would be far greater than statistics indicate.

Chemical Burns: Of all the types of injuries which can occur to the eye, those involving chemical burns are most dependent on immediate first aid treatment for the prevention of permanent and serious visual impairment. In chemical burns of any nature, the extent of the damage to the eye will vary in direct proportion to the length of time the chemical has had to act. Frequently, the time lost in attempting to secure a suitable antidote to apply to the eye will represent the difference between a mild, superficial burn without impairment of vision and a serious second or third degree burn with disfigurement and partial or total loss of vision. In all cases where chemicals have entered the eye, the first thought should be to irrigate the eye thoroughly and immediately with large quantities of water. Speed is important and the use of water is the best and safest of all procedures.

The most common types of chemical burns are those caused by the accidental introduction of acids or bases into the eye. Since we know that acids and bases mutually neutralize each other, it is natural for some persons to assume that the eye should be washed with the opposite chemical so as to neutralize the offending acid or base on the spot. This is a serious misconception which may lead to tragic results. Nothing could be worse for the patient than the addition of a solution of acid or base to his eye for the purpose of neutralizing a chemical already present. In spite of this fact, a review of the literature shows that the authors of many textbooks continue to recommend neutralization of acid burns of the eye with weak alkaline solutions and neutralization of alkali burns of the eyes with weak acids. In most instances, the authors advise that such neutralization should be followed with the use of some oily emollient. These authors disregard entirely the conclusive experimental work that has been done on this subject, or else are entirely unimpressed by this work. They also disregard the fundamental facts of acid-base neutralization as studied by any beginning student of chemistry.

In experimental studies by Cosgrive and Hubbard[5] it was found that the proper treatment of acid and alkali burns of the eye is the immediate and thorough dilution of the offending chemical by irrigation with water, other types of treatment being either contra-indicated or unneces-

sary. These experiments were carried out on the eyes of a large group of rats and rabbits. The results agreed with the results of similar experiments by Davidson, who showed conclusively that the intensity of an acid or alkali burn of the skin is increased by the use of a neutralizing agent. Davidson's experiments also demonstrated that dilution is more effective than neutralization as a first aid method. Cosgrive and Hubbard found that immediate dilution by irrigation is of the utmost importance for a favorable prognosis. They suggest that water, being abundant, is the proper fluid for irrigating the eyes and that speed in the removal of the chemical is absolutely necessary since the extent of the injury depends almost entirely upon the length of time the chemical is permitted to act on the tissues. These workers found that neutralization without irrigation is absolutely contra-indicated and that the use of a neutralizing fluid in preference to water is of questionable value. They also report that neutralization after irrigation with water had no effect in their experiments.

Cosgrive and Hubbard attempt to explain their observation as follows:

> Attempted neutralization with a weak solution without irrigation does not adequately neutralize the offending chemical and, of course, it would be illogical to use a very strong neutralizing fluid. Neutralization after irrigation is not of any importance. In an eye that has been burned by an acid and then has had treatment by immediate irrigation, one of two conditions can exist—either there is no free acid present or free acid is present in extreme dilution and is, therefore, unimportant. In this case, the seat of the burn becomes covered by an insoluble acid metaprotein. The addition of a weak alkali may now dissolve this metaprotein and react with the exposed cells to cause still further precipitation and destruction. In the case of an alkali burn, a soluble proteinate is formed which permits the alkali to enter the cells and cause dehydration. This action of an alkali probably accounts for the fact that alkali burns are more severe than acid burns. The actual neutralization of an acid or base calls for the use of relatively strong neutralizing fluids. The use of such solutions would be illogical on such delicate membranes as are found in the eye.

It would be assumed that persons working regularly with chemicals would be aware of this fact. However, Allen[6] cites the case of a young woman laboratory technician who splashed one drop of a tenth-normal sodium hydroxide solution into her eye. She immediately washed it out with an ounce of tenth-normal hydrochloric acid solution. The result was a severe and unnecessary acid burn.

In irrigating an eye that has been burned by a chemical, water should be used copiously and an effort should be made to reach every fold of the conjunctiva with the fluid. Obviously sterile water is to be preferred but if this is not immediately at hand tap water should be used. The lids should be held away from the eye so that the water may reach to the cul-de-sacs. The patient should preferably be in a supine position and the irrigations should be repeated time after time. Frequently, when the burn is severe or when the patient is extremely nervous, the operator

may experience some difficulty in turning or raising the lids. Under such circumstances it would be well to attempt some irrigation, then to secure superficial anesthesia by instilling into the conjunctival sac a few drops of a topical local anesthetic. After this has been secured, the irrigation should be continued. After all trace of the offending chemical has been removed, petrolatum or a bland non-irritating oil should be applied as an emollient. This will prove soothing to the inflamed conjunctiva and lid surfaces and will prevent adhesions.

Occasionally when treatment has been delayed or when the burn has been severe it will be impossible to raise the lids because of adhesions between the bulbar and palpebral conjunctiva. In order to secure thorough irrigation it is necessary that these adhesions be separated gently by the use of a smooth, blunt probe which is run carefully between the tissues. Unless this is done irrigation will not be complete and the chemical will continue to react. During the healing process the use of emollients should be continued and the eye should be protected with sterile dressings and watched carefully for adhesions. These must be separated if they occur. When there is considerable oedema the patient will receive comfort and benefit from the use of cold compresses. Butesin picrate ophthalmic ointment affords the anæsthetic properties of butesin and the antiseptic and healing properties of picric acid. It may, therefore, be of benefit in such cases but should never be used until after thorough irrigation of the eye with water.

The successful treatment of the following emergency illustrates the value of the above procedures. Late one evening a young woman was brought in who had accidentally splashed acid into her face and eye. The acid had been washed from the face and eyelids but not from the eye itself. When the eye was examined, some twenty minutes after the accident had occurred, the bulbar and palpebral conjunctivae were so completely adherent that it was impossible to open the lids. Treatment consisted of immediate irrigation with distilled water, which because of the adhesions was not thorough, followed by instillation of anesthetic ointment. After the induction of anesthesia the adhesions were separated with a blunt probe and the irrigations with water continued. After complete flushing, a solution of fluorescein was instilled into the eye. It was found that the cornea and conjunctiva were completely stained. Subsequently, butesin picrate ointment was instilled every three hours and at each instillation any adhesions present were separated. After thirty-six hours of such treatment the cornea and conjunctiva were completely healed, as evidenced by the fact that they did not take a stain when treated with fluorescein.

In addition to the danger encountered when an excess of acid or base is put into the eye, there are two more adverse results produced when an acid neutralizes a base. First, the interaction of these chemicals produces neutral, acidic or basic salts which in themselves may be highly irritating and damaging to the eye. Second, the neutralization of acid with a base produces a considerable quantity of heat, which, if the chemicals be present in considerable amounts, may be sufficient to cause additional damage. The author does not know of any direct examples involving the eyes, but he does know of a case where a student in a beginning chemistry class accidentally spilled a quantity of concentrated sulfuric acid across his arm. His fellow student working next to him saw his predicament and thinking to be helpful poured a solution of ammonium hydroxide over the acid. The acid was neutralized, but the heat generated in the neutralization was so great that it burned the area of skin and the flesh under it severely enough to hospitalize the unfortunate student. Such drastic treatment of an eye would undoubtedly have necessitated an enucleation!

One type of chemical burn of the eye which requires somewhat different treatment than that discussed above occurs in the case of lime burns. Such burns are of great importance because of the relative frequency of their occurrence, there being many occupations in which lime in one form or another is used, and because of the disastrous results which often ensue. Contrary to usual opinion the damage does not result from the heat generated by the lime, slaked lime causing as much or more damage than unslaked lime. A lime burn is a chemical burn followed by an infiltration of insoluble calcium salts into the tissues. This deposition of chalk-like material in the cornea results in clouding and in the development of a leukoma which interferes seriously with vision. Despite the fact that water assists in diffusing the lime into the tissues, it is best to remove the particles by the mechanical flushing action of a gentle stream of water.

In addition to immediate flushing with water the lids should be carefully and fully everted to expose every part of the conjunctiva. Any pieces of lime that adhere to the conjunctiva or cornea should then be removed with a cotton tipped applicator or eye spud. Unless these pieces are removed, a complete necrosis of the underlying tissue will take place. Topical anesthesia should precede the removal of the lime encrustations. Opacities formed by the infiltration of insoluble calcium compounds into the tissues may be dissolved out by the use of a two to five per cent solution of ammonium chloride over a long period of time. Dean[7] suggests for this purpose the use, two or three times daily

for a week to a month, of a 5 or 10 per cent solution of freshly prepared, carefully neutralized ammonium tartrate. This reacts with the insoluble calcium compounds to form calcium tartrate, which is very soluble. Curcio[8] suggests that lime burns of the eye should be treated by alternate flushings of the eye with copious amounts of water and generous irrigations with a 5 to 10 per cent solution of freshly prepared and neutralized ammonium tartrate. He suggests that this water—ammonium tartrate cycle be gone through several times at each sitting and that treatment be continued until all evidence of opacification has disappeared. Topical anesthesia should precede each cycle.

Another type of chemical burn that is occurring more and more frequently today is that caused by "tear gas." We now find that many banks and business houses are equipped with automatic devices which expel this gas in the event of a "holdup" or burglary. In addition, police forces and riot squads make frequent use of the gas to quell riots and other illegal gatherings. Chemically "tear gas" is chloracetophenone, a white or gray crystalline solid, possessing a sweet aromatic odor like that of locust blossoms. It was used during World War I in the form of shells, hand grenades, candles and air bombs. Lacrimation is said to be produced by a concentration in the atmosphere of as little as 0.0003 mg. per liter of this gas. Vedder[9] reports that when persons are exposed to the action of "tear gas," their chief complaints are irritation of the eyes and lacrimation and burning of the more tender portions of the skin. Men exposed to low concentrations for long periods of time or to high concentrations for short periods of time were unable to open their eyes for 24 hours. A small amount of tear gas has comparatively little effect on the skin, but when an excess is applied it produces a burning sensation, slight rubefaction and sometimes small vesicles on the skin's surface.

The first aid treatment recommended for tear gas in the eyes is the same as for other chemical burns in so far as immediate and thorough flushing is concerned, but the Chemical Warfare Service has recommended that this treatment should be followed by the instillation of a solution of sodium sulfite made by dissolving 0.5 gram of the salt in a mixture consisting of 25 c. c. of water and 75 c. c. of glycerine.

Thermal Burns: Thermal burns of the eye are met with less frequently and generally are less serious than chemical burns. Such injuries may be listed as scalds from steam or hot liquids such as water, fat, soap or lard, and burns caused by such objects as curling irons, lighted cigars and cigarettes, shreds of tobacco blown from pipes and tips from matches. In addition to thermal burns caused by these objects

we might include such other domestic causes as flare-backs from gas ovens and oil burners and explosions of coal gas. As a general rule burns from any of these causes are superficial and confined for the most part to the lids and face. It is seldom that the eyelids fail to close in time to prevent injury to the eye itself.

Thermal burns of the eye are best treated by thorough irrigation with water or a mild bicarbonate of soda solution, followed by the instillation of an emollient oil or petrolatum. When the lids and surrounding skin are involved they are best treated by a cleansing with soap and water followed by annointment with an emollient.

Cruthirds,[10] Kuhn[11] and others have recommended the use of a high concentration of sulfhydryl, a colloidal sulfur compound, the proprietary name of which is hydrosulphosol, in the treatment of burns of the eye and the surrounding skin. Kuhn lists the following steps in caring for burns of the eye: (1) Copious irrigation; (2) Anesthetization with a topical anesthetic; (3) Staining with a 2 per cent fluorescein solution; (4) Additional irrigation and a search for particles; (5) Instillation of one drop of a 4 per cent homatropine solution, if the burn is mild, or a 0.05 per cent atropine solution, if burn is severe; (6) Filling of the entire conjunctival sac gently with Ophthalmic Hydrosulfosol, using a dropper; (7) Application of a pressure bandage, using two eye pads held in place very snugly by an Elastoplastic bandage; (8) The pressure bandage is not to be removed for twenty-four hours, after which treatment is to be repeated; (9) When the burn is associated with a corneal burn, an eye patch soaked in Ophthalmic Hydrosulphosol is to be laid on the lids and an Elastoplastic bandage is to be applied; (10) In minor burns of the lids, a loosely-wound cotton tipped applicator dipped in aqueous Hydrosulphosol can be used to paint the lids, or the solution may be sprayed on the lids as it quickly forms a dry flexible membrane which requires no other covering.

In industry thermal burns of the eye are frequently occasioned by glowing metals or by masses that have become heated during the process of manufacture. It would seem that such injuries would be necessarily severe when we take into consideration the dual factors of heat and a foreign body; but generally speaking such injuries inflict only moderate damage, probably because they are in contact with the eye for but a fraction of a second and because of a thin film of watery vapor which arises from the eye and protects it by reason of the cold produced by rapid evaporation. An excellent example of this physical phenomenon is the fact that a person can plunge his hand into a pot of melted lead and withdraw it quickly without receiving injury. Wurdemann[12] cites

the case of a plumber who came to him with a moderate burn of the bulbar and tarsal conjunctivae and eyelids, stating that a few hours before he had upset a pot of solder, some of which had splashed in his eyes and face. A large piece had been picked out of the corner of his eye by a fellow workman and he had brought along the piece for examination. The piece was three-quarters of an inch long and weighed four grams. It was curved so that it fitted the side of the nose and the space between the aperture of the lids. The injury was comparatively slight consisting of superficial burns involving the skin of the nose and a portion of the conjunctiva.

Burns from molten iron, steel, slag and other metals with a high melting point are usually more severe than those caused by lead and solder, but are still not usually very serious by reason of the physical phenomenon stated previously. Frequently, burns caused by heated metals are further complicated by the fact that they strike with considerable velocity and thus inflict mechanical damage that is often more serious than the burn itself. This is especially true of chips of metal which are sharp or jagged. Fortunately the seat of such injuries is usually aseptic by reason of the fact that the object was heated. The purpose here, in addition to treating the burn with an emollient, is to maintain the aseptic state of the injury.

Electric sparks, lightning, welding arcs and the reflected light of the sun from the snow, sand and water are all responsible at times for injurious effects upon the eye, chief of which is probably an erythema of the conjunctiva resembling a burn. Such agents are also responsible for causing cataractous changes in the lens. They can also cause corneal lesions which resemble sunburn of the corneal epithelium. Also, by reason of the concentration of the excessive amounts of light by the refracting system of the eye, they can do considerable damage to the retina. The treatment of conjunctival and corneal burns is the same as that for ordinary thermal burns, i. e., the use of sodium bicarbonate irrigations and the use of Ophthalmic Hydrosulfosol. Retinal lesions are best treated by the use of protective (tinted) lenses and by adequate rest of the eyes.

Traumatic Injuries: Explosions of gunpowder and dynamite account for a large number of ocular injuries requiring first-aid treatment. It is indeed fortunate from the standpoint of the ocular welfare of our people that the rather uncivilized method of celebrating American Independence with fireworks is gradually disappearing and with it the tremendous toll of persons made blind by "Fourth of July" accidents.

Most of the ocular injuries resulting from the explosion of gun-

powder are a combination of burns and penetration of foreign bodies. Usually there are, at the very least, first degree burns of the face, eyelids, conjunctiva and cornea, with the added impaction of grains of powder. These powder grains must be removed at once or otherwise they will leave lasting tattoo marks and permanent disfigurement. The grains of powder should be lifted out one at a time, after previous anesthetization of the cornea, with the aid of an eye spud or needle knife. Subsequently, an antiseptic solution or ointment should be instilled in the eye to prevent infection.

Several years ago we had occasion to render first aid to a boy eight years of age whose eye had been injured in a Fourth of July accident. The youngster was in a stooping position when another child threw a small torpedo which struck the sidewalk just a few inches from the patient's eye. Torpedoes of this sort contain a quantity of very small pebbles and these pebbles were thrown with explosive force against the child's right eye. When the eye was examined several minutes after the accident, it was found that one of the pebbles had penetrated the cornea at the limbus and was lodged in the anterior chamber. In addition, there were numerous non-penetrating lacerations of the cornea and conjunctiva. By careful manipulation the pebble was removed through the path of entrance. Fortunately, the iris was not injured. Treatment consisted of bathing the parts with warm sodium bicarbonate solution, followed by instillation of one per cent atropine and 1:3000 metaphen ointment. Subsequently, the child was seen daily in consultation with an ophthalmologist. Despite atropinization, traumatic cataract developed within thirty-six hours. Vision was reduced to 20/200 in the affected eye. Uneventful healing of the cornea and conjunctiva took place within several days. When the eye was examined later, it was found that vision was improving gradually. Within three months the cataract had been absorbed to the extent that vision was 20/30.

Traumatic injuries of the eye may be divided into two classes: non-penetrating and penetrating injuries. Unquestionably, foreign bodies lodged in or on the conjunctiva or cornea compose the largest portion of all classes of injury to the eye. All sorts of substances such as bits of glass, paint, coal dust, emery, cinders, thorns and particles of metal may become lodged in the eye. In all cases the immediate treatment consists of removal of the foreign body. This should be done as promptly as possible in order to prevent inflammation, sloughing and ulceration.

When the foreign body has become lodged on the sclera, it is quite possible to effect its removal by the use of a sterile cotton-tipped appli-

cator previously dipped in a solution of sodium bicarbonate. When the foreign body is imbedded in the sclera or scleral conjunctiva, it may be necessary to use a blunt eye spud. When the foreign body lies on the upper palpebral conjunctiva, the upper lid must be everted so as to expose the foreign body. This may then be removed by the method described for removing foreign bodies which lie upon the sclera.

When the foreign body is located on the cornea, whether imbedded or not, it will usually be necessary to anesthetize the cornea before attempting removal. While many times it is possible for a skilled person to remove a body so located without an anesthetic, there is always an element of danger in that the patient may make a sudden movement that would cause the applicator or spud to damage the cornea. This danger can largely be obviated by the preliminary instillation of a drop or two of a topical anesthetic. When the foreign body is superficially located on the cornea, it can usually be wiped off with a sterile cotton-tipped applicator or picked up with a blunt spud. When it is embedded, considerably more skill is required and a sharp spud is generally to be preferred. In this case anesthesia is a necessity. Frequently, removal will be facilitated by the use of a stain, such as fluorescein. This stain will "take" only when the limiting membrane of the cornea has been abraded. Therefore it will stain only the area occupied by the embedded foreign body. Good illumination and magnification secured by the use of a "Berger loupe" or other similar device are essential. A monocular loupe is not so satisfactory as a binocular one because it does not afford stereopsis which is essential to the safe removal of an embedded foreign body from the cornea.

When the foreign body is composed of iron or steel it can readily be removed with the aid of a magnet. The small electromagnets designed for this purpose are fairly inexpensive and will readily pay for themselves in the ease and facility with which they remove magnetizable substances.

Following the extraction of a hot metallic foreign body or of a foreign body containing iron which has been lodged in the cornea long enough to become oxidized, it will be found that the cornea is stained with a ring of brownish, burned or oxidized tissue. If this ring is allowed to remain, it may produce a permanent scar or it may prove irritating to the eye because of its rough edges or it may provide a harboring place for bacteria and be the cause of a later infection. Therefore, it must not be permitted to remain. A dental burr held in a suitable handle should be used to remove this tissue, thus eliminating the dangers of irritation and infection. Burrs for this purpose are procurable from

any dentist or dental supply house. The handle may be improvised from any ordinary glass screw tap handle or a handle made expressly for the purpose may be secured from the Pilling Company of Philadelphia. After the removal of any foreign body, regardless of its nature, an antiseptic should be instilled to offset the danger of infection. For this purpose, a solution of Ophthalmic Metaphen 1:3000 or Ophthalmic Metaphen ointment or one of the newer antibiotic preparations should be instilled in the affected eye.

Contusions: Contusions of the eyeball, depending upon their severity, produce varying degrees of injury to the structure of the eye. Roemer[13] has arranged the most important changes that occur in non-rupturing contusions of the eye as follows:

1. Hemorrhages into the eyelids.
2. Hemorrhages beneath the conjunctiva.
3. Cloudiness and erosions of the epithelium of the cornea.
4. Hyphema.
5. Iridodialysis and irideremia.
6. Radiating lacerations of the iris.
7. Traumatic mydriasis or miosis.
8. Laceration of the sphincter and the individual layers of the iris
9. Inversion of the iris.
10. Paralysis or spasm of accommodation.
11. Cataract.
12. Subluxation and luxation of the lens.
13. Hypotonia and hypertonia.
14. Hemorrhage into the vitreous.
15. Commotio retinae.
16. Retinal hemorrhages. Changes in the macula.
17. Detachment of the retina.
18. Choroidal hemorrhages with patches of pigmentation and discoloration.
19. Rupture of the choroid.
20. Crushing and laceration of the optic nerve; hemorrhage into its sheath.

A contusion may also be followed by a circular opacity of the anterior surface of the lens. This opacity may be brownish in color due to adherent iris pigment (Vossius' ring). Exophthalmos following contusion is produced by effusion of blood or air into the retrobulbar space. Enophthalmos following contusion is the result of a fracture of the orbital rim. This results in enlargement or widening of the orbit with separation of the fragments, or cicatrical contraction of the orbital tissues and extrusion of a portion of the orbital contents through the bony wall (Berens[14]).

Very little treatment is required in caring for most non-perforating contusions of the eye. Probably the most important first-aid measure in most injuries of this sort is placing of the eye at rest by the instillation of a 1 per cent atropine solution and the application of cold compresses to control the edema of the structures.

The following case is an instance of the ofttimes serious sequelae

resulting from apparently slight, non-perforating injuries of the cornea: A man about 30 years of age was removing tacks from an upholstered chair with the aid of a tacklifter when the head of one of the tacks broke off and struck the cornea with considerable force, causing intense pain and lachrymation. About one-half hour later an examination of the eye revealed a slight abrasion at the pole of the cornea with considerable conjunctival edema and hyperemia. No other injury was apparent—ophthalmoscopic examination was negative. A mild antiseptic was instilled and the patient was instructed to bathe the eye at regular intervals with a solution of sodium bicarbonate. Within twenty-four hours all signs of inflammation had disappeared and the patient reported no discomfort. Several days later he complained of a dimness of vision. Examination disclosed the presence of a traumatic cataract with a visual acuity of 20/200. Over a period of months some absorption took place and now, some 15 years later the vision is 20/50.

Rupturing contusions of the eye occur through a combination of compression and inward pressure, which cause bursting when the limit of resistance of the structure is reached. Generally, they are caused by blunt or round objects, usually of large size, which strike the eye with considerable force. Most indirect ruptures of the globe occur at the weakest part of the sclera which, according to Muller, is just behind the limbus. Usually a blow of sufficient force to rupture the sclera causes damage in other parts of the eye so that the prognosis is bad. In favorable cases where the iris, ciliary body or lens are not affected, the eye will heal without a great loss of vision. In general, first aid measures in rupturing contusions of the eye consist of a cleansing of the part, the use of antiseptics, the use of atropine and the application of bandages.

Penetrating Wounds: Penetrating wounds of the eyeball are more common in the anterior part of the eye. They may be determined by the presence of a visible laceration of the cornea or sclera which gapes on pressure, by a reduction in tension, by the prolapse of pigmented uveal tissue, or by the prolapse of the vitreous in a wound of the sclera. This vitreous matter is generally in the form of a stringy viscid mass which favors infection and prevents healing if allowed to remain. When the wound is of such a nature that only the aqueous is allowed to escape it may be diagnosed by a shallow anterior chamber and a flattened cornea. The fact that none of these signs exists in a given case should not be considered as conclusive evidence that penetration did not occur. In many instances, small, thin foreign bodies have penetrated the eyeball with no visible evidence of a wound and because of quick closure of the small wound there was no appreciable reduction of tension.

After removal of the cause, penetrating wounds heal with or without inflammation, depending on the presence of infection. First-aid treatment of such cases would constitute removal of the cause, careful removal of any tissues which may be included in the wound and the use of antiseptic dressings.

Frequently, objects which penetrate the eye remain within the globe. Every effort should be made to learn the character, force, direction and possible infectiousness of such a foreign body, since the prognosis and treatment will probably be largely dependent upon such information. First-aid measures in cases of foreign bodies within the globe are largely limited to the instillation of antiseptics and the application of sterile dressings.

In gunshot wounds and in all cases of ocular injury where the wounds are contaminated with dirt or have been exposed to infection due to delay in receiving treatment, the patient should be given prophylactic injections of tetanus antitoxin. Because of the great amount of pain incident to most eye injuries, some thought should be given to the patient's general comfort and an effort should be made to secure relief from pain by the administration of analgesics.

REFERENCES

[1]Atomic Energy Commission, Sixth Semiannual Report, United States Government Printing Office, Washington, D. C., 1949.
[2]Atomic Energy Commission, The Effects of Atomic Weapons, United States Government Printing Office, Washington, D. C., 1950.
[3]Berens, C. F., Atomic Medicine, Thos. Nelson & Sons, New York, 1949.
[4]Cogan, David G., Martin S. Forrest, and Kimura, Saul J., Atomic Bomb Cataracts, Science, *110*, 654 (1949).
[5]Cosgrive, C. K., and Hubbard, W. B., Acid and Alkali Burns of the Eye, An Experimental Study, Annals of Surgery, *87*, 89, (1928).
[6]Allen, Thos. D., First Aid in Eye Injuries, Illinois Medical Journal, *69*, (1936).
[7]Dean, Walter, Immediate and Secondary Treatment of Eye Injuries, Kentucky Medical Journal, *34*, (1936).
[8]Curio, Michael, Private Communication.
[9]Vedder, E. B., The Medical Aspects of Chemical Warfare, Williams and Wilkins Co., Baltimore, Md., 1925.
[10]Cruthirds, A. E., Importance of Sulfhydryl in the Treatment of Corneal and X-ray Burns, American J. of Surgery, *72*, 500-509, (1946).
[11]Kuhn, H. S., Eyes and Industry, C. V. Mosby Co., St. Louis, Mo., 1950.
[12]Wurdemann, H. V., Injuries of the Eyes, C. V. Mosby Co., St. Louis, Mo., 1932.
[13]Roemer, P., Textbook of Ophthalmology, Rebman Co., New York, 1917.
[14]Berens, C., The Eye and Its Diseases, W. B. Saunders Co., Phila., Pa., 1950.

EFFECTS OF PROLONGED TELEVISION VIEWING ON CERTAIN OPTOMETRIC FINDINGS*

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INTRODUCTION

In a previous article,[1] a survey was made of the prevalence of visual complaints related to television viewing. This survey served to indicate that many patients with visual complaints readily identify their visual discomfort with television viewing. The absence of correlation of complaints with age and frequency or duration of viewing did not point to any specific optometric or visual malfunction responsible for the visual discomfort. This left the obvious need to explore other avenues for the factors giving rise to visual discomfort during television viewing.

The present experiment was designed as a further investigation into the possible causes of visual discomfort.

METHODS AND PROCEDURE

Five volunteer observers, students of the Los Angeles College of Optometry, watched television for a period of 12 continuous hours. All of these observers were between 21 and 28 years of age. The subjective refraction of each observer is recorded in Table I. Only two of the observers (C. P. & A. M.) wore corrections. These corrections were worn constantly during both the television viewing and the examination periods.

TABLE I
Subjective Refraction of Each Subject

Observer	Subjective Refraction O.D.	O.S.
GH	+0.25 ⊖ +0.25 X 180	+0.25 X 180
GC	+0.25 ⊗ +0.25 X 90	Plano
AK	+0.50 X 90	—0.25 ⊖ +0.75 X 90
CP	—2.25 ⊖ +0.50 X 180	—2.75 ⊗ +0.50 X 160
AM	+1.00 ⊗ +0.50 X 100	+2.50 ⊗ +1.50 X 90

Meals were served to the observers without interrupting their viewing of the television screen. Lounging chairs were provided for all ob-

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servers in an attempt to make viewing conditions as comfortable and as home-like as possible. Station channels were changed any time that the observers indicated a desire for a change in programs. The observers were allowed to smoke and talk to each other during the course of the experiment. They were also instructed that they might change the positions of their chairs whenever desired. This was done only once and by only one observer. The only thing required of observers was that they watch the television screen continuously and not allow their gaze to wander. To provide an incentive for watching the screen, the observers were told at the beginning of the experiment that they would be given a comprehension test based on various programs which they had seen during the day. The observers were also attended during most of the experimental period by a monitor to see that they actually gave their attention to the television screen at all times. The comprehension test itself was never given.

In general, the viewing conditions were made to conform to those popularly recommended as the most desirable. A television set* with a 19-inch screen, the largest direct viewing tube available at the time, was used. The television receiver was equipped with a yellow-green filter which has been described in a previous article.[2] Illumination in the test room was provided by louvered ceiling luminaires equipped with silvered bowl incandescent lamps. None of these luminaries was situated directly over any of the observers or the television set and none was in the line of sight of any of the observers or visible to any of the observers by specular reflection at the surface of the picture screen or the cabinet. Windows in the test room had their shades drawn, but were not completely sealed against the entrance of light. This resulted in slightly different room illuminations during daylight and evening hours. The illumination values measured periodically with a Macbeth illuminator are indicated in Figure 1. The observers were situated at an average of approximately 15 feet from the television set.

Viewing began at 9:00 a. m., the time at which daily television broadcasting begins in the Los Angeles area. Each observer was subjected to a series of clinical tests before the viewing period began. This same series of tests was repeated at three-hour intervals until the full 12 hours had elapsed. In this way five determinations of each optometric test were recorded with a space of three hours between each recording.

The optometric findings included the phoria at 6 meters, the phoria at 40 centimeters, the ACA gradient (as described by Morgan[3]), base-in and base-out prism findings at 40 centimeters, and the amplitude of

*Loaned by the Hoffman Radio Corporation.

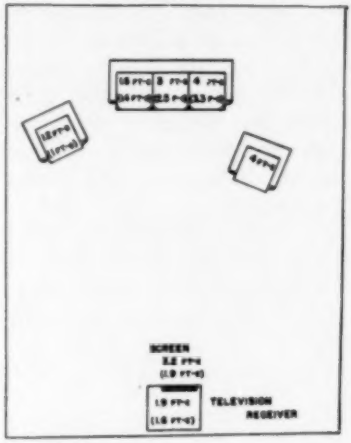

Fig. 1. Floor plan of the test room showing seating arrangement and average illumination levels obtained during daylight hours and during evening hours, the latter in parentheses.

accommodation. The tests were administered in the above order at all times. These findings were selected to provide direct measures of the five fundamental variables described by Fry.[4] At the conclusion of each test period the pupillary responses to light—direct and consensual—and the degree of conjunctival injection were noted. The testing and the television viewing were conducted in the same room. The test apparatus consisted of a phorometer trial frame containing Risley prisms of 30 prism diopters maximum power before each eye and graduated in one prism diopter steps. The apparatus was situated on one side of the room and was far enough removed from the observers and television set so as not to interfere in any way with the television viewing.

The 6 meter phoria was measured by the Von Graefe dissociation technique. The target for this test consisted of a 20/30 line of Snellen type 6 meters distant from the observer. With the subject seated behind the phorometer, the rotary prism before the left eye was set for 6 prism diopters base down. This amount of prism was sufficient to create a vertical diplopia of the test target for all the observers. The measuring Risley prism before the right eye was set at about 10 prism diopters base-in and gradually reduced in power until the observer reported that the lower line of letters was directly under the upper line of letters. This was checked two or three times during each examination by passing the indicated value and returning to it.

The phoria at near was determined by the same dissociation method as the distance phoria. Here, however, 12 prism diopters of base-down prism was placed before the left eye in order to minimize the effects of peripheral fusion. The target set at 40 centimeters from the spectacle plane consisted of a white card on which was printed a small square containing a series of finely ruled horizontal lines. The observer was instructed to carefully concentrate on the lower image of the target and make every effort to see the fine lines clearly while, at the same time, noting the position of the upper image. The rotary prism before the right eye was then rotated until the lower image was reported as being directly under the upper image. This end-point was rapidly rechecked three or four times by over-passing the indicated value and returning to it.

For the gradient finding, a pair of +1.00 diopter spheres was placed in the phorometer trial frame and the near point phoria measurement repeated. The change occurring between this test and the previous near-point phoria was recorded as the accommodative-convergence accommodation (A.C.A.) ratio. This recording is also known as the gradient.

Following this, the +1.00 diopter spheres were removed and the prism base-in and base-out to blur, break, and recovery findings were taken. The target was the same as that used in the near-point phoria test; namely, a small square with finely ruled horizontal lines.

Accommodative amplitudes were obtained first on the right eye, then the left eye, and then binocularly. Donders' push up technique was used in obtaining these measurements. The test object consisted of a photographically reduced Snellen chart. This chart was mounted on the housing of an ordinary carpenter's self-winding steel tape measure. For the amplitude measurement, the end of the steel tape was placed just above the eye being measured on the supra-orbital margin, or at the radix nasi when the binocular amplitude was being recorded, and the tape, with the mounted chart, was extended away from the observer until all the letters of the chart could be read easily. Next, the observer was instructed to read the bottom line of type, which was the smallest, and to report when it first appeared blurred. The tape was then slowly reduced in length, which in turn brought the reduced Snellen chart closer to the observer's eyes, until the observer reported the blurring of the small type. Three or four such readings were made at each test period to insure accuracy. The mid-point of these readings was recorded in inches and later converted to diopters.

RESULTS

The clinical data obtained during the course of this experiment are

shown in Table VI. The several categories of results are discussed in the following paragraphs.

(A) The distance phorias are represented in Figure 3 and also in Table II. Three of the observers were essentially orthophoric, while one was definitely esophoric and one definitely exophoric throughout the test. A careful inspection of the graphs shows practically straight

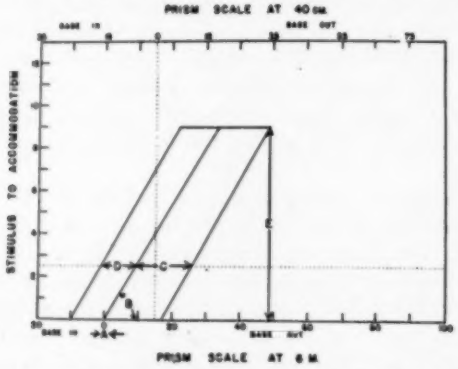

Fig. 2. Schematic representation of the zone of clear single binocular vision, with arrows representing the five fundamental accommodation-convergence variables described by Fry.[4]

horizontal lines in all cases, indicating no apparent shift during the 12 hour test period. The greatest variation, 3Δ, shows up in subject A. M. However, there is only a 1Δ difference between the first and last readings and no difference between the mean of the first two phoria findings and the mean of the last two phoria findings.

TABLE II
Mean of Phorias at Six Meters

Observer	Mean 1, 2	Mean 4, 5
GH	+0.75	0
GC	—0.75	+0.50
AK	0	+0.25
CP	+3.00	+2.00
AM	—5.50	—5.50
Algebraic Total	—2.50	—2.75
Mean	—0.50	—0.55

The results of the group as a whole, as seen in Table II, show a difference of only 0.05Δ between the group average for the first three hours and the group average for the last three hours, or the mean of the first two findings and mean of the last two findings. The difference

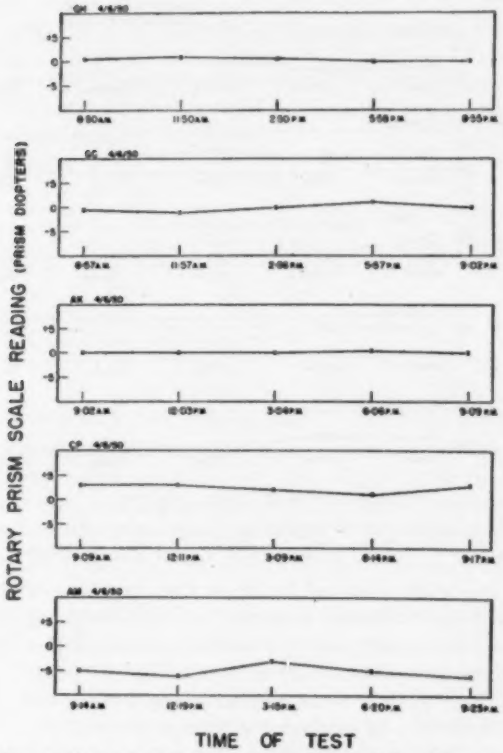

Fig. 3. Six-meter phoria measurements for all five observers.

between the group mean for the initial tests and the group mean for the final tests is 0.20Δ. The probability that this latter difference might have occurred by chance is 0.5, which means that this difference is far from significant.

(B) The accommodative convergence gradients (ACA ratios) for all observers are shown graphically in Figure 4. Two methods for determining the ratios are represented, one, the directly "observed" ACA ratio which consisted of the change in phoria induced by a pair of +1.00 diopter spherical addition, and the other, the "calculated" ACA ratio determined according to the following formula adapted from Fry:[4]

$$\text{A.C.A. ratio} = \frac{15 - 6 \text{ M. phoria} + 40 \text{ Cm. phoria}}{2.50}$$

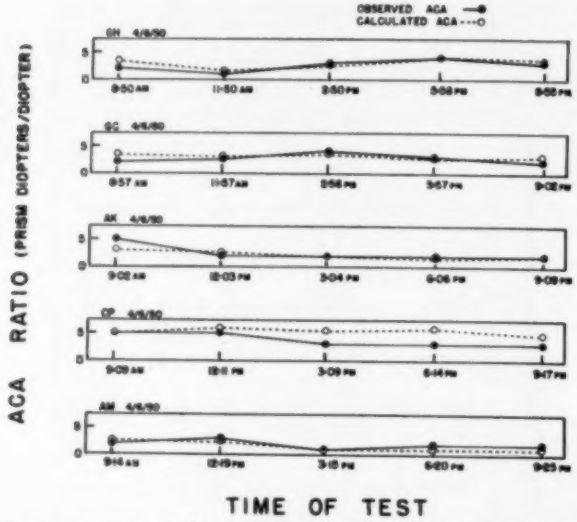

Fig. 4. Ratios of accommodative convergence in prism diopters to accommodation in diopters (ACA ratio or gradient) for all five observers.

Differences in values obtained by these two methods of determining the ACA ratio are ordinarily attributed to such sources of testing error as the awareness of nearness of the test object and depth of focus effects on apparent accommodation measurements. In the present series only one subject (C.P.) showed an appreciable difference, indicating that, in general, the sources of testing error were at a minimum.

An inspection of the graphs in Figure 4 shows no apparent trend or shift of either the "observed" or "calculated" values. Because of the slightly greater variance of the "observed" values their statistical differences were noted and tested for significance. The difference between the mean "observed" value of all observers for the first three hours and the mean "observed" value of all observers for the last three hours is only —0.35. The difference between the mean of the initial values and the mean of the final values for the group was —0.80. The latter difference is not significant, however, as it could have occurred by chance more than one time out of two.

(C) The positive limit of the zone of clear single binocular vision, also called the limit of positive fusional convergence or the limit of positive relative convergence, and shown as variable C in Figure 2, is represented by the prism base-out-to-blur finding, or by the prism base-

out-to-break finding when no blur is observed. In this series of tests the breaks were recorded even when they occurred after a blur, but they are not taken to represent the fundamental variable C in Figure 2 as described by Fry.[4] Similarly, the recovery findings were noted as a matter of incidental convenience and are reported here without reference to the variables identified in Figure 2.

TABLE III

Base-out limits of clear single binocular vision with test object at 40 Cm. Examination Period.

Observer	1	2	3	4	5
G.H.	22	28	17	25	19
G.C.	26	32	24	30	30
A.K.	12	6	7	14	8
C.P.	27	25	22	21	29
A.M.	20	12	9	11	15
Mean	21.4	20.6	15.8	20.2	20.2

The values representing the positive (base-out) limits of clear single binocular vision are given in Table III. The blurs, breaks, and recoveries are shown in Figures 5 and 6. A careful inspection does not disclose any continued or persistent trend. The difference of —1.20 between the mean of the initial tests and the mean of the final tests is insignificant.

The only apparently characteristic deviation is the reduction in the base-out findings during the middle of the 12 hour period. It is interesting to note that in all five subjects the mid-period, or six hour findings, were lower than the average of either the subsequent or preceding findings. The shift approaches statistical significance. The inference to be drawn is not clear, though it must be kept in mind that an inadvertent variation in examination procedure during the sixth-hour tests could easily have produced this type of variation as a testing artifact.

The supplementary break-beyond-blur findings and the recovery findings show no statistically significant tendencies that could not be accounted for on the basis of ordinary experimental error. Certain variations that did occur may, of course, have as much significance as the variations in the data discussed in detail above, but because they are not known to relate directly to the five fundamental variables, and since so few basic facts about their physiological interpretation are known, no theoretical analysis was attempted.

(D) The negative limit of the zone of clear single binocular vision, also called the limit of negative fusional convergence or the limit of negative relative convergence, and shown as variable *D* in Figure 2,

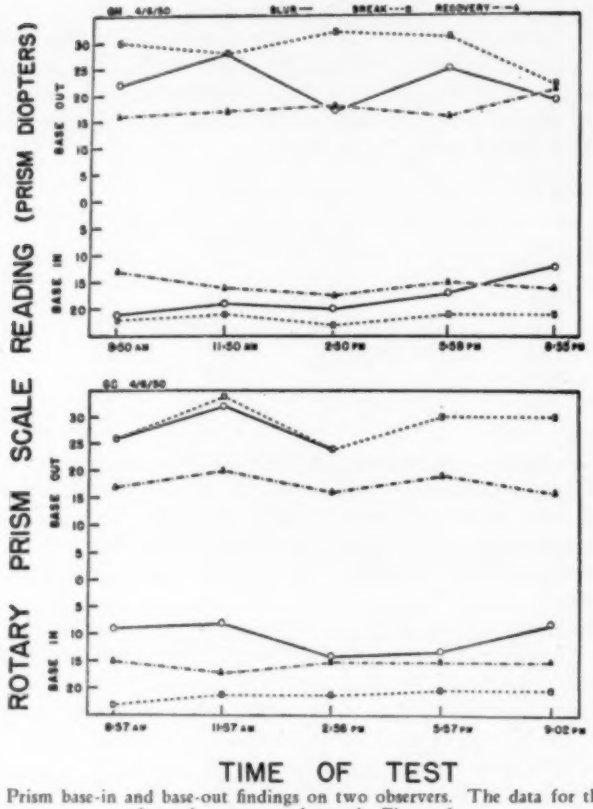

Fig. 5. Prism base-in and base-out findings on two observers. The data for the other three observers are shown in Figure 6.

is represented by the prism base-in-to-blur finding, or by the prism base-in-to-break finding when no blur is observed. As in the positive series the breaks beyond the blurs, and also the recovery findings, were noted as a matter of incidental convenience. The base-in prism data for the five subjects are represented in Figures 5 and 6. The means of the base-in limits of clear single binocular vision are given in Table IV.

TABLE IV

Mean Values of
Prism base-in limits of clear single binocular vision at 40 Cm.

Examination Period	1	2	3	4	5
Mean	17.4	16.4	19.8	19.2	16.0

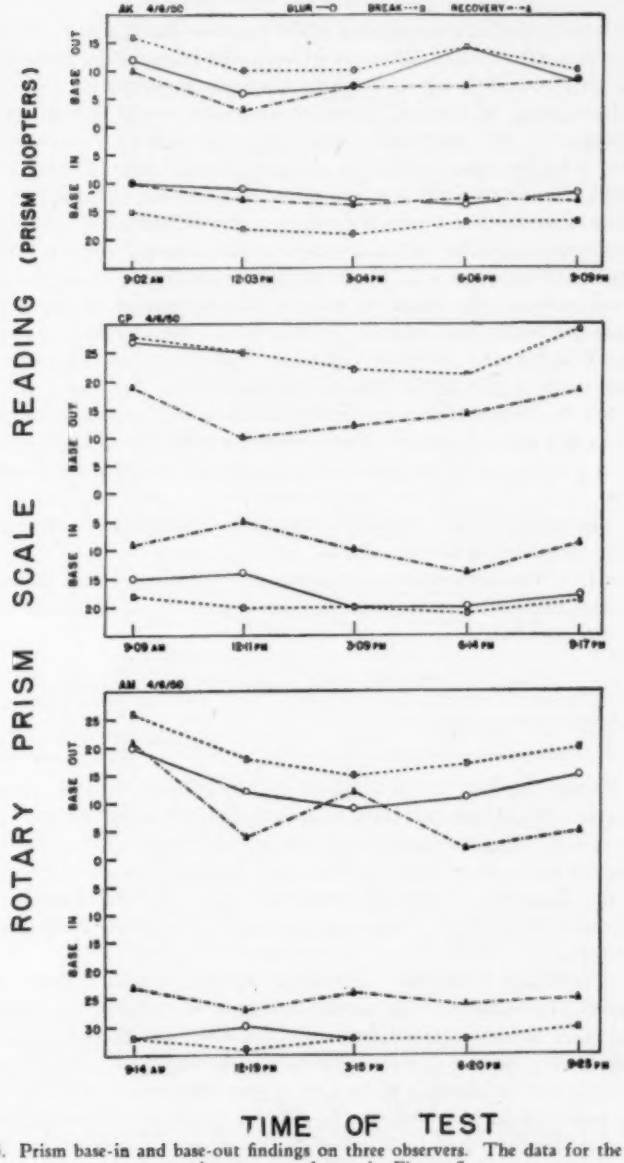

Fig. 6. Prism base-in and base-out findings on three observers. The data for the other two observers are shown in Figure 5.

Inspection of the graph and table does not disclose any continued or persistent trend. The difference of —1.40Δ between the mean of the initial tests and the mean of the final tests is not significant.

In support of the mid-period characteristic noted in the base-out measurement is the comparable observation that each of the five subjects showed a higher base-in limit at the midpoint of the 12 hour period than the averages of either the subsequent or preceding findings. In combination with the base-out findings there is represented a shift of the zone of clear single binocular vision toward less convergence, or toward the left as represented in Figure 2, at the midpoint of the 12 hour television viewing interval. As stated in the previous discussion of the shift of the base-out limits, the inference is not clear. That the shift approaches statistical significance is quite apparent. The failure to obtain a comparable shift in the distant phoria findings or in the A. C. A. ratio identifies the characteristic as one associated with fusional convergence alone, or as a testing artifact. That it is not a result of television viewing itself is evident, since the shift did not persist through the entire 12 hours.

The supplementary break-beyond-blur findings and the recovery findings show no significant trends.

(E) The amplitude of accommodation findings, both monocular and binocular, are shown graphically in Figure 7. The means of the binocular amplitudes are shown in Table V.

TABLE V
Mean Values of Binocular Amplitudes of Accommodation

Examination Period	1	2	3	4	5
Mean	12.3	10.9	11.4	11.3	10.9

Except for the initial findings of one subject (C.P.), there are no marked deviations or trends in the amplitude findings during the 12 hour period. The unusually high initial amplitude finding for C. P. appears to be an anomalous finding when compared to all of the others, but even though it is averaged with the others, the difference between the mean of all initial findings and the mean of the final findings is not significant.

(Incidental Findings) Pupillary reflexes seemed normal in all observers at all times. The observed degree of conjunctival injection varied from period to period, but there was never any marked hyperemia in any of the observers. Two observers seemed to have a slight increase in conjunctival hyperemia at the end of the experiment, while the other three appeared to have less at the conclusion of the investigation.

All observers had been asked to report ocular discomfort or discomfort of possible ocular origin at any time. Two observers (A. K.

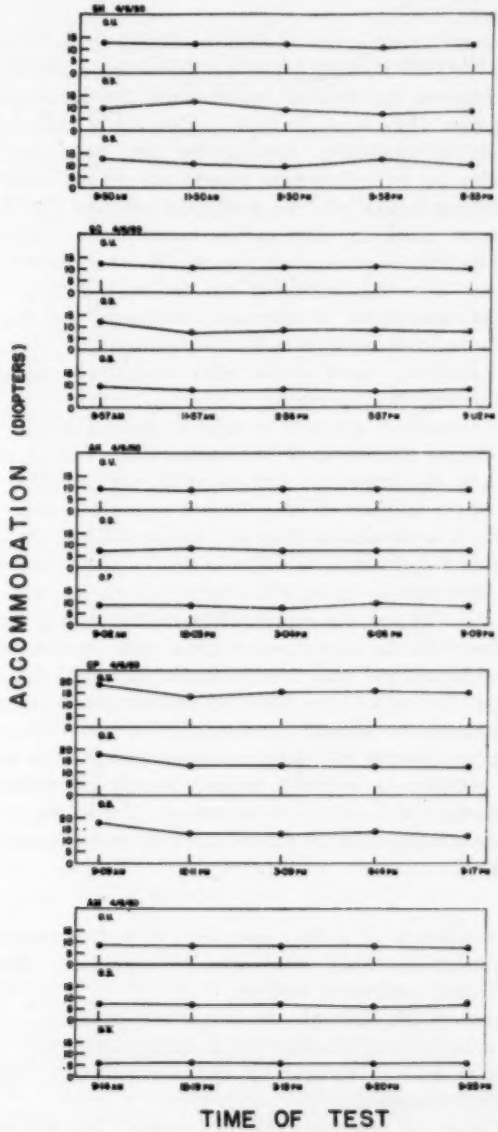

Fig. 7. Accommodation amplitude findings for all five observers.

and C. P.) made no subjective complaints during the entire experiment. Three hours after the viewing began, two observers reported an uncomfortable feeling in the frontal region and the remaining observer reported his eyes "beginning to pull." This latter observer (A. M.) made no further complaints. During the fifth hour observer G. H. reported both eyes as feeling sore nasally and by the ninth hour he reported a frontal headache. The remaining observer (G. C.) reported a slight frontal headache close to the tenth hour. Observer G. H. appeared to be affected more than any of the other observers. He had been subjected to severe headaches on the days both preceding and following the experiment. A physician examining the observer a few days after the experiment diagnosed these headaches as "due to a simple nervous irritability." None of the other observers reported headaches the day following the experiment.

Ocular discomfort appeared to have no bearing on the tests which were made during the course of this experiment. The graphs of those individuals who did experience discomfort do not appear to be different from those of the individuals who did not experience ocular discomfort or headaches. The amount of sleep each individual had the night before the experiment did not seem to influence any of the results either. The amount of sleep varied among the observers with the minimum being four hours (G. C.) and the maximum being nine hours (A. K.)

The five subjects represented a good cross section in regard to ametropia—one myope, one anisometropic hyperope, one low order astigmat, and two who were virtually emmetropic. The group was, however, restricted to a relatively small age range. None of the five observers gave histories of television viewing difficulties and so they cannot be regarded as entirely comparable to individuals who list television viewing as a source of asthenopia. However, the volunteer subjects were unselected with respect to their past experiences in television viewing.

SUMMARY

In five subjects of college age who viewed television programs continuously for 12 hours, there were no significant changes in the following clinical optometric findings:

Phoria at 6 M. through the distance correction,

Phoria at 40 Cm. through the distance correction,

Phoria at 40 Cm. through the distance correction, combined with +1.00 spheres O.U.,

Prism base-out and base-in-to-blur, break, and recovery findings at 40 Cm.,

Monocular and binocular amplitudes of accommodation,

TABLE VI

Clinical Test Findings Obtained During Twelve Continuous Hours of Television Viewing

Subject	Exam. Period	Phoria 6 m	Phoria 40 cm	Gradient	Prism Base Out	Prism Base In	Accommodation O.D.	O.S.	O.U.
G.H.	1	1/2 eso	6 exo	2/+1.00	22/30/16	21/22/13	9.6	12.5	12.7
	2	1 eso	10 exo	1/+1.00	x/28/17	19/21/16	12.7	10.3	12.3
	3	1/2 eso	8 exo	3/+1.00	17/32/18	20/23/18	9.1	9.6	12.2
	4	ortho	5 exo	4/+1.00	25/31/16	17/21/15	7.7	12.3	11.2
	5	ortho	6 exo	3/+1.00	19/22/21	12/21/16	8.8	9.7	12.3
G.C.	1	1/2 exo	7 exo	2/+1.00	x/26/17	9/23/15	12.2	9.1	12.5
	2	1 exo	8 exo	2/+1.00	32/34/20	8/21/17	7.5	7.5	10.9
	3	ortho	6 exo	4/+1.00	x/24/16	14/21/15	8.7	8.1	10.9
	4	1 eso	7 exo	3/+1.00	x/30/19	13/20/15	8.7	7.1	11.0
	5	ortho	7 exo	2/+1.00	x/30/16	8/20/15	7.6	7.7	10.1
A.K.	1	ortho	7 exo	5/+1.00	12/16/10	10/15/10	7.7	8.8	9.3
	2	ortho	9 exo	2/+1.00	6/10/ 3	11/18/13	8.6	8.6	9.0
	3	ortho	10 exo	2/+1.00	7/10/ 7	13/19/14	7.4	7.7	9.6
	4	1/2 eso	10 exo	2/+1.00	x/14/ 7	14/17/13	7.6	9.7	9.6
	5	ortho	10 exo	2/+1.00	8/10/ 8	12/17/11	7.6	8.1	9.1
C.P.	1	3 eso	1 eso	5/+1.00	27/28/19	15/18/ 9	17.9	17.9	18.9
	2	3 eso	3 eso	5/+1.00	x/25/10	14/20/ 5	13.2	13.2	13.7
	3	2 eso	1 eso	3/+1.00	x/22/12	x/20/10	13.2	13.3	15.4
	4	1 eso	1 eso	3/+1.00	x/21/14	20/21/14	12.6	14.3	16.1
	5	3 eso	ortho	3/+1.00	x/29/18	18/19/ 9	12.8	12.1	14.9
A.M.	1	5 exo	14 exo	2/+1.00	20/26/21	x/32/23	7.3	5.7	8.3
	2	6 exo	15 exo	3/+1.00	12/18/ 4	30/34/27	7.3	6.2	8.6
	3	3 exo	16 exo	1/+1.00	9/15/12	x/32/24	7.8	6.3	8.8
	4	5 exo	17 exo	2/+1.00	11/17/ 2	x/32/26	7.1	6.4	8.6
	5	6 exo	17 exo	2/+1.00	15/20/ 5	x/30/25	7.8	6.3	7.9

Inspection of the conjunctiva, lids, and pupillary light reflexes.
Subjective reports of asthenopia.

Analysis was also made in terms of the five fundamental variables in the relationship between accommodation and convergence as described by Fry[4], with no significant changes apparent. A possibly significant shift in the positive and negative convergence limits of the zone of clear single binocular vision was noted at the mid-point of the 12 hour period, but this shift did not persist. This observation points to the need for investigation of diurnal variations in the related optometric findings.

REFERENCES

[1]Hofstetter, H. W., A Survey of Visual Complaints Related to Television, American Journal of Optometry and Archives of American Academy of Optometry, Vol. 26, No. 11, Nov., 1949, pp. 483-489.

[2]Stein, H., Hofstetter, H. W., and Graham, R., The Effect of Light Absorbing Filters on the Discernibility of a Television Test Pattern, American Journal of Optometry and Archives of American Academy of Optometry, Vol. 28, No. 1, Jan. 1951, pp. 19-29.

[3]Morgan, M. W., Analysis of Clinical Data, American Journal of Optometry and Archives of American Academy of Optometry, Vol. 21, No. 12, Dec. 1944, pp. 477-491.

[4]Fry, G. A., Fundamental Variables in the Relationship Between Accommodation and Convergence, Optometric Weekly, Vol. 34, Nos. 6 and 7, pp. 153-155, 183-185, March 18 and 25, 1943; reprinted in Optical Developments, Vol 20, No. 1, Jan. 1950, pp. 1-6.

EYELESSNESS IN CAVE ANIMALS*

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INTRODUCTION

Of all of the structures existing in the typical vertebrate, the eye in many ways is the one most intricately organized for its specific function. Anyone engaged in the field of visual care is in a position to appreciate this fact. From the standpoints of physiology, anatomy, and dioptrics, the organ of vision is eminently adapted to the function of assisting the organism in keeping aware of its environment. This is true in spite of the aberrations which the eye is known to possess. Indeed, when one considers the many circumstances that may arise, it is surprising that ametropia, high though it is in incidence, is so relatively low in degree. The relatively high degree of organization exhibited by the human eye may lead us to speculate as to what modifications may be evolved in future ages. Certainly the human eye today, as at no time in its past, is a "near-point" eye. Although this may have significance for refraction and visual training it does not necessarily have significance for permanent, inherited modifications. Despite the claims of geneticists in certain parts of the world, the general scientific evidence today points to the fact that acquired characters of the parents are not transmitted to the offspring. Accordingly, in order to establish itself as a permanently inherited characteristic of the human eye, a modification in our visual apparatus should theoretically have the selective survival value of better adapting the individual to his environment. In this respect, those of us who are engaged in visual care by applying more effective treatment to more and more individuals are, in effect, working against such a "natural selection" of modifications in the eye, since we are assisting the visually "unfit." Indeed, there are individuals, fortunately few in number, who are opposed to many aspects of health care on the grounds that the "survival of the fittest" is thereby made more difficult. In this respect, we may well realize that "survival of the lucky" may also be a factor in evolution. Even more significant is the mounting body of biological evidence to the effect that "cooperation" is an exceptionally strong factor in evolution (Allee, 1931, 1938).

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In view of the anatomical and physiological specialization of the vertebrate eye for the performance of its function, it is of interest to consider certain animals whose eyes have degenerated more or less completely. The eyes of eutroglobionts, or animals completely confined to life in dark caves, are generally reduced to functionless vestigial structure or even entirely absent. Such animals usually show a compensating development of tactile organs. These cave animals are generally negatively phototropic; that is, they will move away from an illuminated area.

In spite of the abundant records of the existence of blind cave fauna, careful anatomical studies, both gross and histological, are few in number. Quite recently, a number of excellent investigations have been carried out, notably by Breder and his associates, not only on the anatomy of certain blind cave fishes but also on their behavior, the latter topic having aspects of interest in the field of physiological optics.

ANATOMICAL STUDIES

Among the first contributions to the ocular anatomy of blind cave forms was the work of Eigenmann (1909). Working with *Rhineura floridana*, a species of lizard, Eigenmann found that this form had the following ocular characteristics: The dermis and epidermis pass over the eye with no modification; there are no external ocular muscles; there is no differentiated cornea; the crystalline lens is absent in more than one-half of the specimens; there are no rods and cones but some of the layers of the retina have "reached a degree of differentiation out of proportion to the great reduction of the dioptric apparatus and the general structure of the eye."

Studies by Eigenmann on the eye of the cave fish, *Amblyopis*, revealed that in the later stages of growth the eyes become distended vesicles whose parts, with the exception of the scleral cartilages, are finally resorbed after undergoing degeneration. There is almost no vitreous body or vitreous cavity. There is neither a crystalline lens nor an iris. The retina shows a well-developed inner reticular layer. The inner and outer nuclear layers are merged into one. There are no rods, but occasionally some cones are found, and there is a well-developed pigment epithelium layer. Actually, the crystalline lens appears embryologically in this species at the normal time. However, the cells never lose their embryonic character and the lens is resorbed at an early stage. The optic nerve appears at an early stage in the growth of the fish. However, it does not increase in size with the growth of the animal and possibly never develops normal nerve fibers. In older specimens, the optic nerve dwindles and becomes lost.

More recently, excellent studies have been reported on the ocular anatomy of *Anoptichthys jordani* by Gresser and Breder (1940). This species is a Mexican cave fish, which is blind. Genetically, it is continuous with the normal, eyed, river fish, *Astyanax mexicanus*, from which it differs only in its lack of a developed eye and body pigmentation.

Anoptichthys jordani is about 56 mm. long. The average ocular dimensions are 1.5 mm. vertically, 1.5 mm. horizontally, and 1.2 mm. anterio-posteriorly. The eye is overlapped by folds of epidermis which are in contact with a solid mass of condensed mesenchymatous tissue corresponding to the cornea. The external ocular musculature has become differentiated and the optic nerve is present in outline. In the opinion of Gresser and Breder, the primitive optic vesicle has undergone its first invagination and at this level has failed to differentiate beyond a pigment layer and a retinal layer. According to these investigators, it is conjectural at this stage of development of the eye whether the forces of genetic, hormonal, or intracellular metabolic control have failed to stimulate the overlying epithelial cells to form lenticular tissue or whether the epidermal column that is present represents this attempt. However, whether the eye stops development because no lens develops and produces in turn the fusion of the poorly differentiated primary vesicle into a cyst or vice versa, no functional vision is present in either case.

The eye of *Anoptichthys jordani* has a well-marked cartilaginous sclera which is replaced anteriorly by a laminated, translucent, fibrous tunic representing interstitial tissue of the cornea. The primary optic vesicle, although differentiated and invaginated, still forms a complete cyst, precluding the presence of a pupillary opening or the development of iris tissue as such. The choroidal layer is as well defined as the sclera.

Of the retinal layers, the pigment epithelium is the best defined. The inner nerve fiber layer is weakly developed. The ganglion cell layer is composed of a single layer of cells. There are no defects in the inner plexiform layer. The inner nuclear layer is definite but lacks structural delineation while the outer plexiform layer is weak and thin. The outer nuclear layer and the layer of rods and cones show the poorest degree of development.

Only at the center of the vesicle is there evidence of a vitreous body, a loose syncitium of cells representing the vitreous mass. The optic nerve has not been separated into fascicles and has not been supplied with an intraneural supporting framework. The nerve fibers are few and poorly developed.

In later studies, Breder and Gresser (1941) have found forms of *Anoptichthys jordani* whose eyes are somewhat better developed. In

addition to the obviously blind animals with undeveloped eyes just described, two groups of fishes with sunken eyes have been discovered. The eyes of one group, which we may term 2a, are covered by skin epithelium and the eyes of another group, which may be termed 2b, are not so covered.

Specimens of group 2a have fairly well developed globes. The crystalline lens is present in some and when present is found to be smaller than normal. Where the lens is absent, the iris is found to be a weak membrane forming a complete anterior wall to the retinal vesicle.

The fishes of group 2b have eyes of small size which possess an anterior chamber and a well-developed iris with a pupillary space. The lens is present but is small in diameter. The retinas are found to be better stratified than in the previous types but deficient in the rod-cone layer and in the corresponding ganglion cell layer. The optic nerve reflects this deficiency in its size and in the relative absence of nerve fibers.

The lack of general body pigmentation has been correlated with the relative degree of blindness. Thus, in specimens of group 2a, 89 per cent were found with little or no pigmentation and 11 per cent with moderate pigmentation. In group 2b, 77 per cent of specimens were found with little or moderate pigmentation, 15 per cent with considerable pigmentation and 8 per cent with full pigmentation. By contrast, the normal, eyed, related form, *Astyanax mexicanus*, shows 25 per cent of its population with little or no pigmentation, 28 per cent with moderate pigmentation, 23 per cent with considerable pigmentation, and 24 per cent with full pigmentation.

More recently, Breder (1944) reported the discovery of specimens of *Anoptichthys jordani* from another Mexican cave which show a more complete ocular degeneration than previously reported in this species. Hardly anything is left of the eye capsule and there is no optic nerve connected with the brain. There is no recognizable retina, no lens or associated structures, and only a remnant of the choroidal gland. In contrast to the other blind forms which are somewhat light negative, this group is found to have no clear reaction to light at all. In view of this fact and on the basis of their ocular anatomy, these specimens must be considered as "totally blind."

SPECIAL STUDIES

Data have been published by Browman to indicate that rats whose eyes are enucleated on the day of birth have a slower rate of growth regardless of the conditions of light under which they are reared. It is postulated that some "principle" is elaborated by the retina which is essential to normal growth and development.

In this connection, specimens of *Anoptichthys jordani* are blind but have light sensitive cysts in an orbital cavity. These may be removed with impunity, the only result being a loss of light sensitivity. In investigating further the question of the presence of a growth principle in the eye, Breder and Rasquin (1947) had three groups of fishes exposed to light: one with the ocular cysts removed, another with the optic nerve cut, and a third untouched group which served as a control. At the same time, three other similar groups of fishes were kept in darkness. No differences in growth were noted between the various groups of fishes kept in either darkness or light. Accordingly, it must be concluded that the retinal elements of *Anoptichthys* play no role in the growth and development of this species.

Rasquin (1949) investigated the effect of transplanting the eyes from normal, eyed, river fish of the species *Astyanax mexicanus* to the blind, related *Anoptichthys*. No successful results were obtained with such implants. However, in 5 out of 12 cases, the return of vision was observed after complete section of the optic nerve of the normal, eyed *Astyanax*. Rasquin concludes that in order to have vision restored the cut ends of the optic nerve must approximate one another in the wound, and vascularization must be established before the lens and retinal elements have degenerated.

EYELESSNESS AND BEHAVIOR

The normal, eyed, *Astyanax mexicanus* is a quiescent fish, moving only under evident external stimulus. In sharp contrast, the blind, related, *Anoptichthys* keeps up a continual swimming activity. Specimens of *Anoptichthys*, which have eyes that are unable to form a retinal image but are able to respond to light, behave as do totally blind forms (Breder and Gresser, 1941). Fishes of the previously described group 2a, with relatively defective eyes, respond to shadows but do not strike at food particles as do those group 2b whose visual apparatus, though incomplete, is better organized than that of group 2a.

Experiments by Breder and Gresser (1941) on the sensitivity of the blind *Anoptichthys* to light indicate that this species is light negative. Considering the ocular histology of these forms, further experiments are indicated for determining the least number of retinal elements necessary for light sensation.

Further investigation by Breder and Rasquin (1947) reveal additional interesting aspects of light sensitivity in cave fishes. Some blind cave fishes are found to be light negatives whereas others, from another cave, are found to be light positive. When the optic cysts are

removed, the fishes become indifferent to light. It was found by these investigators that the exposure of the pineal body by the removal of a small patch of guanine results in a light positive reaction in a previously light negative form. On the other hand, covering the pineal area with India ink causes a previously light positive cave fish to become light negative.

In addition to demonstrating the role played by the pineal area in the animal's light reactions, this experiment indicates that any possible effect of radiant heat has nothing to do with observed behavior. The removal of a small patch of guanine or the presence of a drop of ink can hardly be imagined as having any bearing on the response of the fish to warmth. Light positive cave fishes are found to have virtually no dermal melanophores. The anatomical modification in the skulls of the cave fishes is such that light does not have to penetrate the osseous tissue to reach the brain, since the pineal body is directly below a fontanelle.

In general, the eyed *Astyanax* are quiescent, keeping in the shade and facing out into lighted areas. The blind, related *Anoptichthys* have no point of optical fixation and, therefore, are constantly in motion. Being more active they consume more food. A method of analysis used by Shlaifer (1938) was also used by Schlagel and Breder (1947) to demonstrate that oxygen consumption in blind cave fishes is high, a fact which can be correlated with their increased activity. When *Astyanax* is placed in total darkness, its oxygen consumption, and, presumably, its activity, is greatly increased and approaches that of the blind cave fish.

DARKNESS AND ITS EFFECT ON VISION

A number of observations and experiments are available regarding the effect on the visual response of prolonged exposure to darkness. These should be of specific interest to optometrists. Breder (1943) reports the behavior of normal, eyed river fishes which have been found living in caves that communicate with the main river. It is apparent that these fishes have accidentally migrated into these caves only recently. However, they have already adopted the feeding habits of eyeless cave fishes, as can be seen from their manner of performing circling movements in quest of food. When they are removed from their caves and placed in the light, these fishes continue their circling movements for at least several months in an illuminated environment before they gradually begin to learn, or perhaps re-learn, the meaning of a retinal image and slowly take up the normal feeding habits of eyed fishes by striking at food particles.

Breder and Rasquin (1947) obtained normal, eyed fishes that had

been living in caves and kept them in darkness experimentally for two years. They then exposed these fishes to an illuminated environment and noted their graded visual responses. The results were substantially as follows: During the first day of exposure to light, the fishes displayed no reaction to the shadow of a moving object. However, in two to five days some reaction to shadows was evident. By the eighth day, the fishes displayed "excitement" when food was presented but they did not strike at food particles. In 14 to 26 days, the fishes had begun to strike at food, thus indicating that the visual function was again effective.

Ogneff (1911) studied goldfish which had suffered histological degeneration of the retina after being kept in total darkness for three years. Although he states that the fishes had become blind, he does not mention whether or not they displayed any sensitivity towards light.

Pearse (1938) comments on the fact that a large body of circumstantial evidence is available to indicate that normally eyed fishes and amphibians retain their vision when reared in the dark, but he admits that critical experiments are in order on this point.

DISCUSSION

Considerable speculation exists as to the origin of eyelessness in cave animals. Photopositive and photonegative responses may play a role. Thus, Breder and Rasquin (1947) point out that the survival value of a light negative reaction by a blind fish which inhabits a cave near its outlet is obvious. Photopositive responses would bring the fish into an area of light where it would be helpless against predatory enemies. Photopositive responses in other cave fishes can be tolerated only because they occur in caves which are too remote from surface outlets to permit the fishes to drain out into a lighted environment for which they are not adapted.

Blind cave fishes are found to have a greater oxygen consumption in light than in darkness. This indicates that such fishes have a greater swimming speed in the light which in turn would tend to make these fishes spend more time in the dark. This may be a factor in their entering and remaining in caves. Eyed river fishes are less active in the light and hence would tend to remain in this environment.

Gresser and Breder (1940), in describing the ocular histology of *Anoptichthys*, question whether the structures found represent degenerative changes or whether they represent examples of arrested development. The evidence seems to indicate that a stoppage has taken place in the development of the eye structures at an early stage. Whether the species lost its visual equipment after entering the caves or whether a

mutation with defective vision entered the caves and survived is a speculative question.

We cannot say just how the eyes of any blind fish were led to disappear. It was formerly believed that when the eye becomes useless a positive incentive exists for eliminating the organ, since this would save energy especially during growth of the animal. This notion is not considered seriously today. The proportion of a growing animal's food intake which goes to enlarge the eye is negligible. In addition, the disappearance of the eye does not leave a hole in the head. The volume is replaced by additional tissue, mostly muscle.

Loeb (1915) considers the possibility that the tendency towards blindness in blind cave animals as well as in blind animals that live in the open develops independently of the presence or absence of light. The following facts are cited in support of this concept: The fish, *Typhoblobius*, is found in shallow water, living in holes in the rocks, and in spite of daily exposure to light it is blind. Embryologically, mammalian eyes are developed in darkness in the uterus. Regeneration of the eyes of young salamanders occurs in darkness in areas not connected with the optic nerve. The fish, *Fundulus*, when raised in the dark has completely normal eyes. On an invertebrate level, it was found that when the fruit fly, *Drosophila*, was raised in complete darkness through 69 generations there was no change in the structure of the eye and no change in light sensitivity.

Although we may speculate as to the biological mechanism which caused the eyes of cave forms to disappear, a rational explanation for the phenomenon is difficult. There appears to be no urgent reason for the eye to disappear. Thus, the human appendix may serve no useful function but it has been retained. As indicated by Walls (1942), we may suppose that in the immediate ancestors of the cave species the eye was genetically "trying to disappear" but was prevented from doing so by natural selection as the eye was useful as long as the species remained in a lighted environment.

Only a few cave fishes have retained good, functional eyes. Walls suggests that the species which have taken up residence in caves have ordinarily been well prepared to get along in lightless surroundings. Their tactile and chemical sense organs are well developed. It would seem, as suggested by Walls (1942), that the typical cave species is one which has taken naturally to the cave and in so doing has welcomed it as a refuge, rather than one which has wandered into the cave accidentally and has been unable to get out.

EVOLUTIONARY IMPLICATIONS

Agassiz maintained that eyeless cave fishes arose through special creation. He stated that "the fishes were created under the circumstances in which they now live, within the limits over which they now range, and with the structural peculiarities which now characterize them."

Against the arguments of Agassiz (Newman, 1921) the following potent facts have been arrayed:

Wherever the caves are totally dark, all animals are blind. If the animals live near enough to the entrance to receive some light, they may have large functional eyes. In all cases, the species of blind animals are closely allied to species inhabiting the district where the caves occur. Thus, blind species inhabiting American caves are closely allied to American species while those inhabiting European caves are closely allied to European species. Finally, in nearly all cases where the animals are blind, structural remnants of eyes can be detected in various degrees of obsolescence.

The inheritance of acquired characters is not accepted today as a valid mechanism in evolution. Thus, even if darkness did cause the degeneration of the eyes of normal fishes which had wandered into caves, there is no evidence that such changes would be transmitted to their offspring. However, the evidence presented here indicates that darkness as such may not permanently affect vision in normal, eyed, fishes although they may be deprived of light for several years.

SUMMARY

The eyelessness of cave animals and the results of anatomical studies on the eyes of cave fishes are discussed. The behavior of blind cave fishes with reference to sensitivity to light and the results of studies on the effect of prolonged darkness on the vision of normal, eyed, related species are described. Factors leading towards eyelessness and the evolutionary implications of eyelessness in cave fishes are presented.

REFERENCES

Allee, W. C. 1931. Animal Aggregations. Chicago: University of Chicago Press.

————. 1938. The Social Life of Animals. New York: W. W. Norton & Co.

Breder, C. M., Jr. 1943. Problems in the Behavior and Evolution of a Species of Blind Cave Fish. Trans. N. Y. Acad. Sci. *5* (7): 168-176.

————. 1944. Ocular Anatomy and Light Sensitivity Studies on the Blind Cave Fish from Cueva de los Savinos, Mexico. Zoologica *29*: 131-144.

Breder, C. M., Jr., and Gresser, E. B. 1941. Correlation Between Structural Eye Defects and Behavior in the Mexican Blind Characin. Zoologica *26*: 123-131.

————. 1941. Further Studies on the Light Sensitivity and Behavior of the Mexican Blind Characin. Zoologica *26*: 289-296.

Breder, C. M., Jr., and Rasquin, P. 1947. Evidence for the Lack of a Growth Principle in the Optic Cysts of Mexican Cave Fish. Zoologica *32*: 29-33.

————. 1947. Comparative Studies in the Light Sensitivity of Blind Characins from a Series of Mexican Caves. Bull. Amer. Mus. Nat. Hist. 89 (art. 5): 319-351.

Eigenmann, C. H. 1909. The Eyes of Blind Vertebrates of North America.
Gresser, E. B., and Breder, C. M., Jr. 1940. The Histology of the Eye of the Cave Characin, *Anoptichthys*. Zoologica *25*: 113-116.
Loeb, J. 1915. The Blindness of the Cave-Fauna and the Artificial Production of Blind Fish Embryos by Heterogeneous Hybridization and by Low Temperatures. Biol. Bull. *29*: 50-67.
Newman, H. H. 1921. Evolution, Genetics, and Eugenics. Chicago: University of Chicago Press.
Ogneff, J. F. 1911. Ueber die Aenderungen in den Organen der Goldfische nach dreijahrigem Verbleiben in Finsternis. Anat. Anz. *40*: 81-87.
Pearse, A. J. 1938. Fauna of the Caves of Yucatan. Pub. Carneg. Instit. Wash. (No. 491): 1-304.
Rasquin, P. 1949. Regeneration of the Optic Nerve After Section With Return of Vision in the Characin. *Astyanax mexicanus*. Physiol. Zool. *22*:131-135.
Schlagel, S. R., and Breder, C. M., Jr. 1947. A Study of the Oxygen Consumption of Blind and Eyed Cave Characins in Light and in Darkness. Zoologica *32*: 17-27.
Shlaifer, A. 1938. Studies in Mass Physiology: Effect of Numbers Upon the Oxygen Consumption and Locomotor Activity of *Carassius aurutus*. Physiol. Zool. *11*: 408-424.
Walls, G. L. 1942. The Vertebrate Eye. Bloomfield Hills, Mich.: Cranbrook Press.

ABSTRACTS

RETINAL CORRESPONDENCE IN PATIENTS WITH SMALL DEGREE STRABISMUS. Arthur Jampolsky. Arch. Ophth., 45, 18-26, January, 1951.

Of 84 patients with esotropia of less than 15°, 92 per cent demonstrated anomalous retinal correspondence on the major amblyoscope when the conditions of testing were adapted to the measurement of the small angle of anomaly. These findings were confirmed by alternative methods, such as: the red glass diplopia test, the Maddox test, and the Tschermak after-image test.

Besides the high incidence of anomalous retinal correspondence and anomalous peripheral fusion in these small angle esotropic cases, there is also a slight amblyopia of the deviating eye with foveal or macular suppression. Orthoptic training usually fails in these cases and the author believes this point needs emphasis because orthoptic treatment is given frequently for eyes that are "almost straight," when the sensorial conditions have been misinterpreted.

R. E. B.

PUBLISHER'S NOTICE: A new manual to assist authors in the preparation of scientific articles has been compiled by the Committee on Mathematical Typography of the American Institute of Physics. This writer's style book will be used as a guide in the preparation of articles published in the journals of the Institute. Copies of this style book may be obtained for $1.00. Orders for the "Style Manual of the American Institute of Physics" should be sent to the American Institute of Physics, 57 East 55th Street, New York 22, New York.

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HOW A PROFESSION IS BORN*†

A vocation evolves into a profession when those members of the vocation who are both competent and scrupulous band together to form a central organization, the prime purpose of which is to afford a guarantee to the public that anyone who is a member of the association has accepted the ideals and responsibilities of professionalism.

The technical knowledge and skill of the professions are so highly specialized that the layman is rarely able to evaluate the quality of the professional services which he purchases. He is not only forced to reserve his own judgment until after the work of the professional man has been

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†Eugene Freeman. Ph.D. Dean. Chicago College of Optometry. Chicago. Illinois. Fellow. American Academy of Optometry.

completed, but even then he is frequently still unable to make an informed and intelligent evaluation.

The sharp difference between the economic policy of business and the professions is clearly brought out here. In the prevailing economic policies of business, the morality of the jungle is accepted as a matter of course. The cryptic saying "business is business," and the historic motto "*caveat emptor*" (let the buyer beware) bear eloquent testimony to the pervasiveness of jungle law in business economics. The professions are accepted by society because they are founded on *trust*, granted freely and unquestioningly by the client or patient, and respected as binding by the professional man. Instead of the law of *caveat emptor*, the primary law of professional morality and economics is the dedication of the professional man to the principle of identifying the interests of the professional man himself with those of his patient or client.

From this point of view, the professions are in their innermost core essentially those vocations which have evolved beyond the culture of claw and fang into a civilized community guided by the Golden Rule. They constitute an advance guard of humanism which has out-stripped the lagging culture out of which they are evolving, and in which they are one of the great civilizing influences.

A good deal of nonsense has been written about the professions, and most definitions of the term serve more to befuddle the mind than to clarify the word. The meaning of the term "profession" is much too rich and varied to permit its being compressed into a single brief definition. The point of view expressed above, however, can be summarized for working purposes in a very simple statement ostensibly cast in the form of a definition: *a profession is an honored and skilled ethical vocation.* While this statement is admittedly too broad to serve as a precise logical definition, it approaches closer to the essence of the term profession than many of the definitions which have been proposed formally for the term, and it has the particular merit of throwing some light on the evolutionary process by means of which new professions are gradually and continuously being born. As a matter of fact, the statement not only contains the essence of the term profession, but from it can be drawn the very generative principle of the evolutionary process which creates the professions. The development of specialized skills, the development of a humane and elevated ethical code, and the winning of the respect of society as an honorific vocation—these are the clearly marked evolutionary stages in the birth of a profession.

Our own profession of optometry has clearly evolved beyond the first stage of the development of special skills, beyond the second stage

of the development of a high minded and humane code of ethics (regulated by a governing central organization which sets standards of training and conduct), and is well along into the third stage in which it is progressively achieving public recognition as an honorific profession.

It is the nature of the genetic evolutionary process through which professions are born that there is no sharp boundary between the successive stages of their development. There is no single climactic event which transforms a vocation instantaneously into a profession. An infant profession is born when a representative number of ethically minded and competent members of a vocational group bind themselves together under the control of a governing society dedicated to the principle of identifying the interests of the members with those of society. But this birth is not the beginning of the profession—it is preceded by a long period of gestation in which the special skills which the vocation demands are acquired and made available to the public, and in which the group conscience is slowly being shaped which endows a vocation with the personality of a profession. Nor can this personality reach its maturity while the infant is still in its swaddling clothes.

Over 50 years of devoted public service, with continuously widening horizons of functions and public responsibilities, and a corresponding elevation in educational and professional standards have been required to bring our own profession of optometry to is present full-fledged maturity.

EUGENE FREEMAN

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

ANNUAL MEETING OF AMERICAN ACADEMY OF OPTOMETRY

PROGRAM AND SPEAKERS

Dr. Meredith W. Morgan, Jr., papers and program chairman for the coming annual meeting of the Academy in December, has announced a tentative program which should bring out a record attendance. Nearly 30 of optometry's prominent leaders will discuss topics of vital interest —the patient as a person; developments in occupational vision; accommodation and convergence; myopia; strabismus, the photochemistry of vision, and color vision, to name a few. Titles of the papers to be

given by the following speakers will be published next month: Dr. Robert Baxter, Warren, Ohio; Dr. Robert E. Bannon, Bureau of Visual Science, American Optical Company, Southbridge; Dr. Dorothy Bergin, Los Angeles; Dr. V. J. Ellerbrock, School of Optometry, The Ohio State University; Dr. Eugene Freeman, Chicago College of Optometry; Dr. Isidore Finkelstein, New York City; Dr. Richard Feinberg, Northern Illinois College of Optometry; Drs. Henry Hofstetter and Monroe Hirsch, Los Angeles College of Optometry; Dr. George Knox, The Ohio State University; Dr. Henry Knoll, Los Angeles College of Optometry; Dr. Fred Kushner, Northern Illinois College of Optometry; Dr. Elwin Marg, University of California; Dr. Meredith W. Morgan, Jr., School of Optometry, Berkeley, California; Dr. Joseph Pascal, New York City; Dr. William P. Schumann, Vineland, New Jersey; Dr. William Smith, Boston, Massachusetts; Dr. Frederick W. Sinn, Pennsylvania State College of Optometry; Dr. Carl F. Shepard, Chicago, Illinois; Dr. Irving Vics, Albany, New York; Dr. William Walton, Merion, Pennsylvania.

Section meetings will be held on orthoptics, contact lenses, occupational vision and aniseikonia.

REGISTRATION

Registration begins at 9 A. M. at the Hotel New Yorker, New York City, on December 8 (Saturday). A business meeting follows registration, and in the afternoon, the technical sessions begin and continue through Tuesday afternoon, December 11. The annual round table banquet will be held Monday evening, December 10. Dress is formal. Hotel reservations should be made as soon as possible.

ANISEIKONIA SEMINAR

The success of last year's pre-convention aniseikonia seminar sponsored by the Aniseikonic Forum has brought inquiries as to whether a similar seminar will be held in conjunction with the Academy meeting this year. Dr. Robert E. Bannon, Forum secretary, reports that if there is sufficient interest, a seminar could be held at Columbia University December 5, 6, and 7. The fee would be $50.00, half of which would be payable at the time of registration and the balance at the beginning of the seminar. Instructors would be Dr. Bannon, Dr. Harold M. Fisher and Dr. Leo F. Madigan, all of whom have had more than 15 years' experience in clinical work and teaching in this subject.

The short course would cover the fundamentals of aniseikonia and the technique of space-eikonometry. Anyone interested in registering for the proposed seminar should contact Dr. Robert E. Bannon, Secre-

tary, Aniseikonic Forum, c/o Bureau of Visual Science, American Optical Company, Southbridge, Massachusetts.

ACADEMY PROBLEMS

The Executive Council of the Academy will meet for two days prior to the meeting to discuss policy matters, and any member wishing to present a problem for council action should get in touch with Secretary Carel C. Koch, 1502 Foshay Tower, Minneapolis, Minnesota.

LOCAL CHAPTER ACTIVITIES

NORTHEASTERN OHIO CHAPTER

Final committee arrangements for Northeastern Ohio's coming annual conference on reading problems took place at the September chapter meeting. At the educational session following the business meeting, dermatologist Herbert Johnson lectured on skin conditions about the eyes, and Dr. Gerhardt Brescher of Western Reserve University discussed a new method for determining aniseikonia.

SOUTHERN CALIFORNIA CHAPTER

Three medical practitioners presented papers on arteriosclerosis for members of the Southern California chapter at the Fall meeting. All of the doctors are associated with the clinic for the study of the disease at Hollywood Presbyterian Hospital. They were Dr. Paul B. Roen, graduate of the University of California Medical School; Dr. Ernest W. Townsend, Tulane University graduate, and Dr. John W. Perry, graduate of the University of Minnesota.

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department: such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

FACULTY CHANGES

Massachusetts College of Optometry announces the addition of two instructors to its teaching staff. Dr. Henry L. Cabitt, M.D., will teach ocular pathology, and Dr. Charles Kent, M.D., cranial anatomy.

Dr. Cabitt is a graduate of Tufts College Medical School, a Fellow of the International College of Surgeons, the Founders Group, board of ophthalmology, International College of Surgeons, and a member of the ophthalmology staffs of Boston City Hospital and the Boston Dispensary.

Dr. Kent was graduated from University of Prague Medical School. He is an instructor in otolaryngology, Tufts College Medical School: a staff member of the Boston Dispensary and the Boston Floating Hospital, and consultant to the Pratt Diagnostic Clinic of the New England Medical Center.

At Pacific University College of Optometry Dr. Henry Schimpf, 1951 graduate of the college, is now instructor of optometry. Dr. Mathew Alpern, Ph.D., The Ohio State University, 1950, has been appointed assistant professor of optometry.

OCCUPATIONAL VISION CONFERENCE AT RUTGERS

Rutgers University has engaged Lansing P. Shield, president of the Grand Union Company, as its banquet speaker for the coming occupational vision conference November 1 and 2. Other speakers include outstanding personalities from industry, medicine, optometry, government and research.

Sylvester Guth of General Electric, Nela Park, will discuss new concepts of lighting on the job. Dr. Hedwig S. Kuhn, secretary of the joint committee on industrial ophthalmology of the A. M. A. and A. A. O. O., will talk on eye injuries in industry and their emergency care. Dr. Henry B. Peters, School of Optometry, University of California, will outline the organizing of a workable visual program.

Government speakers include Commander R. R. Sullivan, chief of the optometry section, Medical Service Corps, United States Navy, and Dr. Robert O'Shea of the Army Medical Service Corps. Commander Sullivan will cover occupational vision hazards, and Dr. O'Shea, the installation and operation of visual programs in industry.

Industrial leaders will cover insurance, labor relations, color in industry and work simplification programs.

OPTOMETRIC FOUNDATION REPORT

A progress report by the American Optometric Foundation indicates four of its five Foundation research fellows are making teaching their objective. By December, Dr. Charles R. Stewart will have completed all research and study for his Ph.D. degree. His study includes the investigation, photographically, of the time characteristics of fusional divergency movements, at The Ohio State University. Dr. Neal J. Bailey, also at Ohio State, is doing his research on the following project, "Does the Anomalous Projector Have a Single Point of View or a Double Point of View of the World?"

At Columbia University, Dr. Daniel Woolf is investigating the mechanism of accommodation, and at the University of California, Dr.

Darrell B. Carter is studying the physiological significance of the various visual lateralities. Each of these four students has indicated he wishes to make teaching in an optometric college his career.

Also currently being aided financially by the Foundation is Louis J. Stoyanoff at Washington University, St. Louis, Missouri. His project is a study to determine if accommodative changes in the act of perceiving are real changes in accommodation and not a function of other uncontrolled factors as some investigators believe.

A research project now being financed by the Foundation is a study of visual problems in viewing television screens. The study is being conducted at the Los Angeles College of Optometry.

NEWS BRIEFS

Dr. Thaddeus R. Murroughs will be the director of Northern Illinois College's new laboratory of binocular seeing, and will also teach at the college. He will continue work on the Chicago Strabismus Research project started some time ago. . . . The board of optometry of the District of Columbia has approved two amendments to its optometry act changing educational standards for applicants as follows: Each applicant for a license to practice optometry must have been graduated from a school which "maintains a course in optometry of not less than five years," and pass an examination in the theory and practice of orthoptics and visual training and the theory and practice of contact lens fitting. . . . Bausch & Lomb Optical Company has established a defense contract department to handle its increasing war orders. Kenneth E. Reynolds will be in charge. . . . The *Pittsburgh Press* paid tribute editorially recently to the work being done by visual specialists in improving eye care for school children. Special mention was made of the relationship between poor eyesight and juvenile delinquency and the part optometrists are playing in preventing such delinquency. . . . Dr. Paul A. Chandler, surgeon at the Massachusetts Eye and Ear Infirmary, Boston, will deliver the fifth annual Mark J. Schoenberg lecture on glaucoma at the New York Academy of Medicine December 3. The lecture is jointly sponsored by the National Society for the Prevention of Blindness and the New York Society for Clinical Ophthalmology.

FACTS OF LITE on PRESBYOPES

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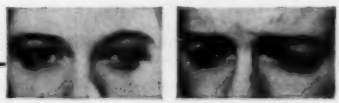
Some presbyopic eyes can take it  . . . some eyes cannot!

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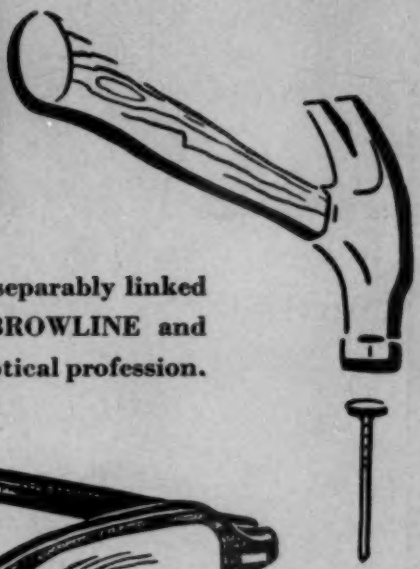

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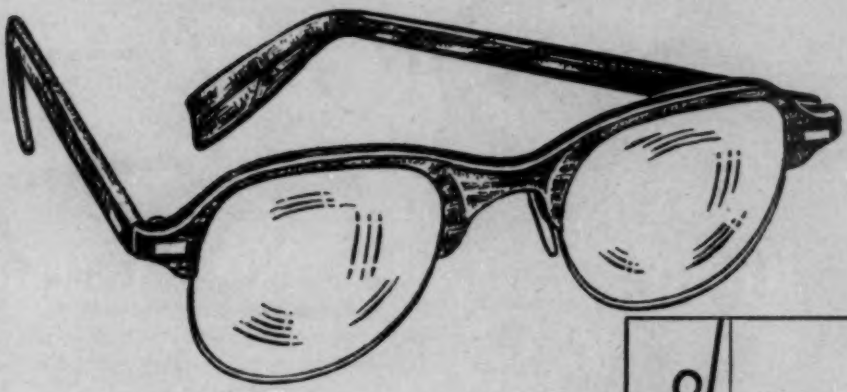

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